Elementary Hygiene

Bhatia and Suri

Orient Longman

ELEMENTARY HYGIENE

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BY

BIHARI LAL BHATIA

D.SC. (Punjab), F.Z.S., F.R.M.S. (London)
Kaiser-i-Hind Medallist,
Late Principal, Government College, Hoshiarpur

AND

PREM NATH SURI

M.B.B.S. (Punjab), F.R.C.P. (Edin.), D.T.M. & H. (Eng.),
Retired Civil Surgeon

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PREFACE

THIS book has been mainly written to meet the requirements of students in High Schools, but it can also serve as an explicit guide to anyone desiring to acquire an elementary knowledge of Hygiene. A companion volume on Elementary Physiology is also available for the same purpose. An elementary knowledge of the salient principles of Physiology is necessary for the proper understanding of the elements of Hygiene. It is, therefore, recommended that the study of Elementary Physiology should precede that of Elementary Hygiene.

A rational and scientific method of treatment of the subject has been followed, as the aim in teaching Hygiene is not to fill the mind of the student with so many rules of health, Do's and Don'ts in fact, but to awaken his curiosity and to enable him to take an intelligent interest in the discovery of the reasons on which those rules are based.

The book is purposely not crowded with technical terms and contains only those that are essential for the purpose of acquiring an elementary knowledge of the subject. The book has been brought up to date and it covers the entire course on the subject as prescribed in High Schools.

A distinctive feature of this book is that it is written with full appreciation of the Indian viewpoint. The authors have been fully conscious of the existing conditions in Indian homes, and have not suggested the introduction of any innovations unless they were convinced not only of the utility, but also of the easy practicability of the practices recommended.

Questions have been supplied at the end of each chapter to facilitate proper assimilation and revision of the matter studied before proceeding with the next chapter.

AUTHORS

PREFACE TO 1968 EDITION

THE book has been thoroughly revised and brought up to date.

Thanks are due to Dr. Harbans Singh Narang, M.D., Ex-Professor, Medical College and Civil Surgeon Retd. for going through the book and making useful suggestions.

P.N.S.

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CHAPTER I

INTRODUCTORY

Health and Disease.—A person is said to be in a state of health so long as the parts or organs of his body go on performing their duties or functions in a normal manner. Any derangement, temporary or permanent, in the smooth working of any of the systems of the organs of the body constitutes disease. Physiology teaches us the normal working of the various organs of the body in a state of health. Hygiene[1] concerns itself with the study of the laws of Health and Prevention of Disease. A knowledge of Elementary Physiology is, therefore, essential to understand correctly the fundamental principles of Hygiene and to grasp fully the grounds on which those principles are based. Of all subjects the study of Hygiene is undoubtedly the most important. The scope of the subject is wide, and includes all that extensive and varied knowledge which enables the individual to keep fit and lead a long and healthy life, and the community to arrange matters so as to make a healthful life for the individual possible. It must be remembered that it is not sufficient to *know* what is the right thing to do. We must do it. Not merely the boys and girls who read this little book, which is only an introduction to a vast subject, but also the men and women who live in this country should act upon the principles set out. During the last few years diseases like Plague have been eradicated, while incidence of Malaria, Smallpox, Cholera and Tuberculosis has been much lessened by the strict observance of the rules of Hygiene. There have been malaria and smallpox eradicating campaigns, which have more or less proved successful. But even now infectious diseases like measles, chickenpox, tetanus, diphtheria, whooping cough, typhoid fever and dysentery are very prevalent. These have to be eradicated by strictly acting on the principles of Hygiene. Action is more effective, far more effective if people have some knowledge of the why and wherefore of the rules laid down, and are not merely given orders they do not understand and which they may, very often, through ignorance, dislike. The plain duty of every student of Hygiene, therefore, is to learn, act, and preach.

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[1] Hygiene is derived from the Greek *Hygeia*, the goddess of Health, who was supposed to look after the health of the people.

The subject is sometimes called Sanitary Science or *Sanitation*. This word is derived from the Latin word *Sanitas* which means a state of health.

Instead of regarding disease (as the ignorant and superstitious sometimes do) as due to the judgment of Providence, or as the work of demons and witches, Science has taught us that we must look upon it as largely caused by the neglect of the laws of health. It is not sufficient that scientific men should find out how diseases can be prevented and that laws should be made by Government to that end. It is absolutely necessary that the whole mass of the people should be made to understand the methods of the prevention of disease, so that they may carry out in their own homes the suggestions of scientifie men.

Result of Improved Hygienic Conditions:—The state of the public health of any country can easily be judged from its vital statistics. In England and Wales, the progress of education and sanitation brought about a marvellous reduction in the number of deaths due to preventable diseases. As shown in the accompanying chart, except during the two world wars, there has been a continuous decline in the death rate from all causes in the successive five year periods. The impact of improved sanitation is particularly noticed in the period 1865 to 1910. In 1865 the death rate was 21.4 per 1000 persons living, in 1910 it reduced to 13.0.

The death rate for India and Pakistan combined in the successive five year periods from 1900 to 1950 is showr in Fig. 2. It also shows a similar fall in the rate of mortality.

Public Health Administration:—At the centre in New

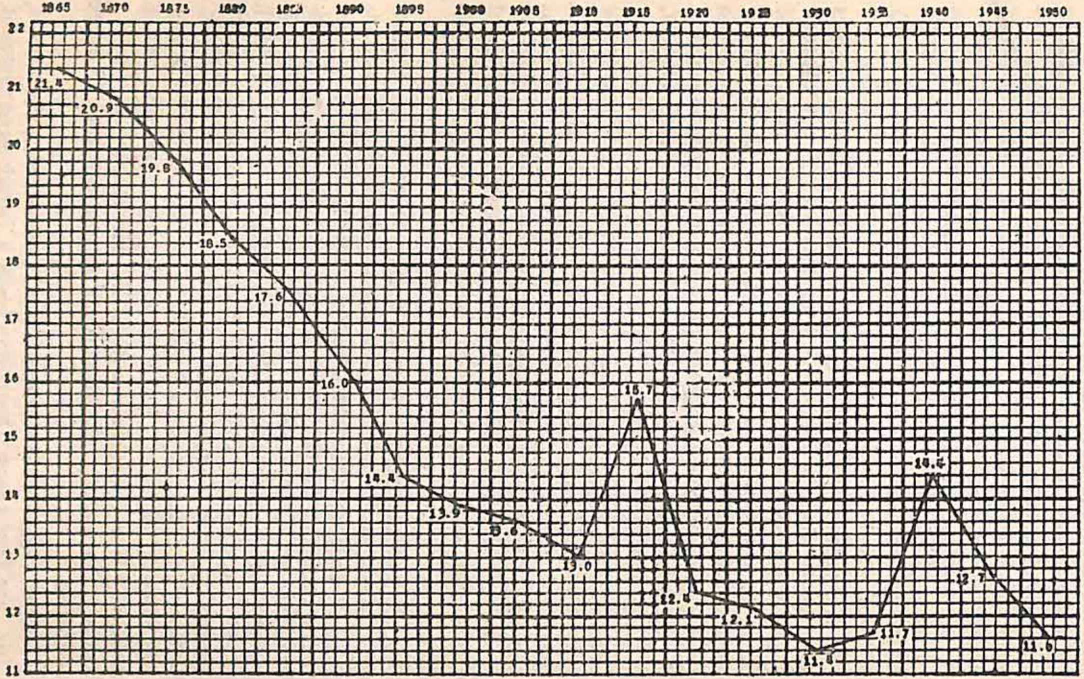

Fig. 1.—Reduction of mortality in England and Wales due to improved hygienic conditions (1865-1950).

Delhi there is the Health Minister who is a member of the Cabinet and has an expert Consultative Committee and Central Council of Health and Consultative Committee of Parliament for consultations. The minister is assisted by the Director General of Health Services who has deputies incharge of various Departments, such as Professional Education and Research, Medical Care, Public Health, Public Health Engineering, Drug Control, Family Planning, etc.

In the states, there is the State Health Minister who is a member of the Cabinet, and State Health Advisory Board for consultation. Under the Minister is the Director of Health Services who is assisted by Deputy Directors-Incharge of Public Health, Medical, Professional Education and Research, Communicable Diseases Control, Maternity and Child Welfare, Family Planning and School Health, Drug Control and Nursing.

District Headquaters:—In the District there is a Chief Medical Officer in charge of both Medical and Health assisted by Deputy Chief Medical Officers (Health) and (Medical). In the District Headquarters hospital there is the Senior Medical Officer Incharge, assisted by Medical Officers and Assistant Medical Officers working in various specialities.

At Tehsil Hospital there is a Senior Medical Officer and a Medical Officer and Assistant Medical Officers incharge of Laboratory work, Blood transfusion, X-rays and anasthesia, etc. In the rural areas each Block has a Primary Health Centre with a male and female Doctor, Sanitary Inspectors (Health Inspector), Lady Health visitors, vaccinators, Auxillary Nurse Midwives, etc. Each Primary Health Centre has six sub centres in a Block, which are staffed by one Auxillary Nurse Midwife and a Basic Health Worker. Both these do intensive field work nad look after Maternal and Child Health work, Family Planning, Malaria, Small-pox Vaccination and Village Sanitation.

ocial Security Measures:—As is clear from the above, in the last few years there has been a rapid expansion in

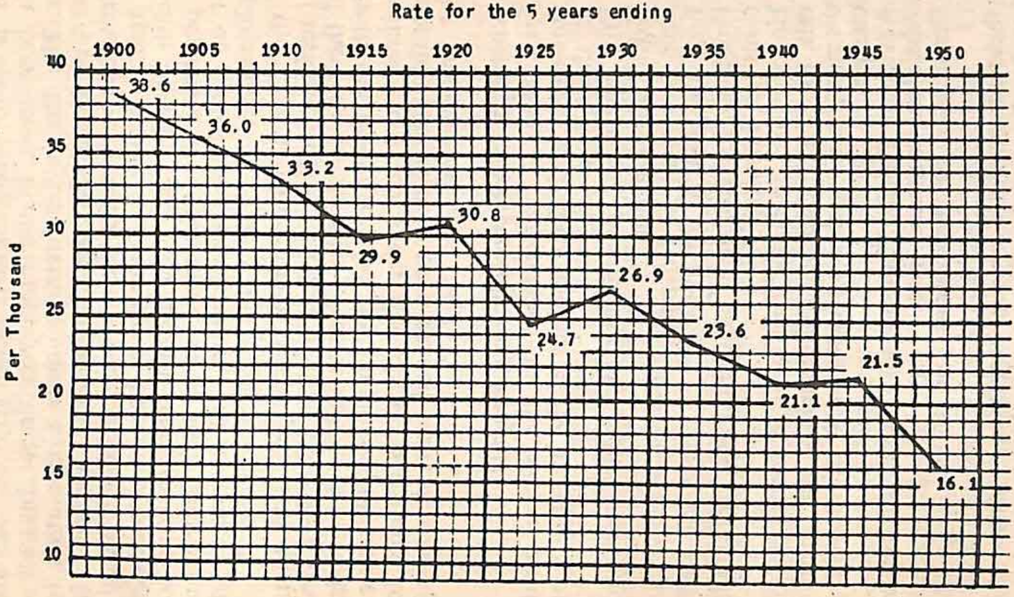

Fig. 2.—Reduction of mortality in India due to improved hygienic conditions (1900-1950).

both the preventive and curative health services. A start has also been made in the Employees Social Insurance Schemes. The Employees State Insurance Corporation is an agency of Social Security for industrial workers. It symbolizes the five benefits the corporation affords—Cash benefit against sickness, Disablement benefit, Maternity and Death benefits, and full medical care in kind to insured persons and to the members of their families on payment of contribution which varies with the wages of the employees.

For the Central Government Employees and their families, residing within the limits of the Union Territory of Delhi, there is a Contributory Health Service Scheme in which both the Employer and the Employee contribute. The beneficiary covered under the scheme is required to pay a monthly contribution on a graded scale, depending upon the emoluments.

The scheme provides the following benefits:—

(1) Free Medical attendance to the Government employees and their families at the dispensary or at their residence.
(2) Free Specialist consultation and laboratory and X-Ray investigation.
(3) Free treatment in Hospitals.
(4) Free supplies of Medicines.
(5) Provision for treatment of Dental and Opthalmic cases at hospitals.
(6) Hospital and specialist treatment in special hospitals for T.B., Cancer, Poliomuelitis and mental diseases, etc. including repayment of travelling charges.
(7) Advice on Family Planning and supply of free or subsidized contraceptives.
(8) Domicilary or institutional midwifery.

But these schemes are only a beginning. Much still remains to be done, such as grants of old age pensions, unemployment assurance, grants to the blind, the handicapped and the dependent and grants for the medical care of the sick. The ultimate ideal however is what is known as National Health Service such as is prevailing in England, where medical care is provided for every person. But at present, it is only an ideal as far as India is concerned, as we have neither the financial nor the medical manpower.

Questions

1. What is Hygiene and what do you gain by its study?
2. What are the results of improved hygienic conditions?
3. Describe the Public Health Administration in India.
4. What do you understand by Employees State Insurance?

CHAPTER II

AIR AND ITS IMPURITIES

Composition of air.—The earth is surrounded on all sides by an envelope of air, known as the atmosphere. Air is a material substance, has weight and as the atmosphere extends for many miles from the surface of the earth, it exercises a pressure on things at the surface of the earth equal to about fifteen pounds per square inch. Pure air has no colour, taste or smell; no wonder, therefore, that under ordinary circumstances we do not perceive its existence, and speak of things really filled with it, as empty.

The air is a mechanical mixture of gases, of which two, oxygen and nitrogen make up nearly the whole bulk. It contains nearly twenty-one volumes of oxygen and nearly seventy-nine volumes of nitrogen. Besides these two gases, air always contains a small proportion of carbon dioxide (also commonly called carbonic acid gas). About one per cent of the volume assigned to nitrogen, is really another gas named argon, which is similar to nitrogen, and from our point of view, need not be separately considered. When we say that air is a mixture of gases, we mean that those gases are not chemically combined in definite proportions to form a body quite different from themselves, as for example, hydrogen and oxygen are combined to form water. The gases forming air, exist in it as such, and the properties of air are simply properties of the gaseous mixture.

The average constitution of the open air may be taken to be as follows :

	By volume
Oxygen	20.96
Nitrogen ..	79.00
Carbon dioxide ..	0.04
	100.00

Besides the above, the air always contains a variable quantity of water-vapour and solid particles (dust) and various gaseous impurities.

Oxygen is the most important constituent of the air. It is a colourless gas without any taste or smell. Without a supply of this gas nothing can *burn*. Any substance that will burn in air burns with greater brilliance when put in a jar of oxygen. If a lighted candle is placed in a limited volume of air, it will burn so long as there is oxygen around it. When a candle (or any other combustible substance) burns in air in an enclosed space, the substances of which it is composed, gradually combine with oxygen, and so the amount of oxygen in the air is gradually reduced, until too little of it is left to support the combustion and the candle goes out. When anything burns it is really *combining with oxygen*. All life is also dependent upon the oxygen contained in the air. If deprived of it, all animals and plants will quickly die. Life is a slow process of burning. All the tissues of the body are constantly combining with oxygen, with the result that a slow and gradual destruction of tissues is going on, accompanied by the production of bodily heat.

Nitrogen also is a colourless, odourless, and tasteless gas. It cannot burn and cannot support combustion or respiration. In the air it serves to dilute the oxygen; we could not live in an atmosphere of pure oxygen, for the combustion of our tissues would be far too rapid.

Carbon dioxide exists in pure air to the extent of .03 or .04 per cent, i.e. only three or four volumes in 10,000 of air. It is a colourless gas, but unlike oxygen or nitrogen, it has a very faint smell and a pleasant acid taste, and is heavier than either of them. In fact it is one and a half times as heavy as air. It is incombustible, and will not support combustion or respiration. A candle immersed in a jar of this gas will at once go out, and an animal will also rapidly die if enclosed in a chamber containing this gas alone. The presence of this gas is easily recognized, as it has the property of turning lime water milky.

Carbon dioxide is being constantly added to the air in large quantities, being produced by the following processes:

(*a*) By all ordinary cases of combustion. In the burning of fires, lamps, candles, coal gas, etc., the carbon of the wood, oil candle or gas combines with oxygen to form carbon dioxide, and the hydrogen given off combines with oxygen to form water-vapour.

(*b*) By the breathing of animals. With each breath some of the oxygen from the air is taken, and carbon dioxide is added to it. The latter is constantly being produced in our bodies by the combustion of the carbon in our tissues.

(*c*) During the process of decomposition and decay of organic matter (dead animals, fallen leaves, refuse, etc.).

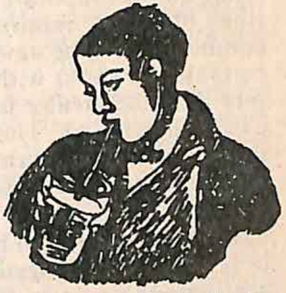

Fig. 3. — Expired air contains carbon dioxide and will turn lime water milky.

The result is that in large crowded towns and in inhabited rooms the amount of carbon dioxide is often above .04 per cent and the air is said to be impure. Although this constant addition of carbon dioxide to air is always going on, still we find that its amount in pure air remains stationery. This is due to the action of the plants. Plants, like animals take in oxygen and give out carbon dioxide, during both day and night. In the case of plants, however, in addition to this process of respiration, another process goes on. All the green parts of plants, in the presence of sunlight, absorb as food much larger quantities of carbon dioxide. The carbon is retained in the plant for its growth, and the oxygen is given back to the air. The chief effect, therefore, of plants upon air, is that they decrease the quantity of carbon dioxide in the air instead of increasing it as the animals do.

Ozone is a gas, traces of which are found in the open air of villages, hill stations and at the seaside. It is a condensed form of oxygen, and therefore, more active in its properties. It is much more effective in decomposing foul organic matter than oxygen and so purifies the atmosphere.

Water-vapour is always present in the air, its presence being due to evaporation that is taking place from all collections of water, respiration of animals, and many cases of combustion. The amount of water-vapour which the air can take up varies with the temperature of the air, the warmer it is, the greater is the amount of water-vapour which can be taken up. This explains why water dries up much more quickly in warm weather than in cold. When air contains as much water-vapour as it can hold at a given temperature, it is said to be saturated. When the air is close to its saturation limit it is said to be moist, and when it is far from saturated it is called dry. As a rule, the atmosphere contains from 1 to 1.5 per cent of water in a state of vapour, or from 50 to 75 per cent of the water required for its complete saturation. If the quantity be much above or much below these limits, the air is either oppressively moist or unpleasantly dry.

Dust.—The presence of solid particles suspended in the air as dust can easily be noticed whenever a beam of sunlight enters a room through a chink or crevice. These solid particles may belong to one of the three following categories:

(1) Mineral or metallic particles—*inorganic* matter.

(2) Particles derived from the animal or vegetable world; *organic* matter.
(3) Bacteria.

Tiny particles of earth, sand, common salt, may be present in otherwise pure air and in a dust storm or sand-storm may give us sore throats or sore eyes. Coal-dust, soot, and metallic particles of various sorts are common in the atmosphere of mines and factories, and the workers in these are known to suffer from lung diseases. Particles of cotton, wool, pollen-grains from flowers, minute seeds, scales of skin (such as easily fall off if you rub any part of your body with your hand), hair, etc., belong to the second kind. Bacteria of many kinds are present in the air but many of them are of the harmless kind. We do, however, run frequent risks of breathing with bacteria which cause tuberculousis of the lungs, the germs of which are ejected in enormous numbers by sneezing, spitting, or coughing of persons suffering from these diseases. The infection of measles and certain other diseases is also spread through the medium of air by dropler or dust infection.

Other gaseous impurities.—Besides the solid particles the air may contain various gases set free by processes of decomposition of organic matter, the most important of these being ammonia and sulphuretted hydrogen. The air from sewers or from cesspools or other temporary collections of water where putrefaction is going on is positively harmful. Carbon monoxide (CO) is a gas different from carbon dioxide (CO_2) and is set free by incomplete combustion of burning coal. It is extremely poisonous, and fatal accidents sometimes occur from coal fires being left burning in a sleeping room with doors and windows closed.

Respiration.—The process of respiration includes all the exchanges of oxygen with carbon dioxide which take place in our bodies; it includes firstly the processes in the *lungs* and secondly in the *tissues*. Breathing consists of inspiration or taking of air into the lungs, and expiration or forcing the air out of the lungs. Alternate enlargement and contraction of the chest cavity brings this about.

Breathing in and out takes place in an adult about 18 times per minute. Further details of this process will be found in the author's *Elementary Physiology*. The blood which has already circulated in the body (venous) is brought back to the right side of the heart from whence it is sent out to the lungs by the pulmonary artery. While circulating in the capillaries of the *lungs*, it absorbs oxygen from the air which is breathed in and gives out carbon dioxide in the air which is breathed out. This oxygenated blood returns to the left side of the heart by the pulmonary vein, and is sent out by the heart to all parts of the body. In the *tissues* the oxygenated or arterial blood is robbed of the oxygen which it carries and becomes laden with carbon dioxide. This venous blood is returned to the heart. The needs of the whole body for oxygen are thus fulfilled, and the air breathed out from the lungs differs vitally from that breathed in. The air that is breathed out, instead of containing only *four* parts of carbon dioxide in 10,000 contains about 450 parts of this gas in 10,000; so while the carbon dioxide is increased, the oxygen it contains is diminished—the amount of nitrogen remaining practically the same.

It is also found that, whether the air which is breathed in be warm or cold, dry or moist, the air which is breathed out is always nearly as warm as the blood and contains as much water-vapour as it is capable of holding. It also contains organic impurities which are the most injurious of all the impurities added to the air by the process of breathing.

The contrast will be seen at a glance from the following table:

	Inspired air.	Expired air.
Oxygen	20.96	16.50
Carbon dioxide	.04	4·50
Nitrogen	79.00	79.00
	100.00	100.00
Water-vapour	variable	saturated.
Organic matter	——	small quantity.
Temperature	variable	that of the body.

It will be seen from the above table that the expired air

(1) contains more carbon dioxide,
(2) contains less oxygen than before,.
(3) contains more water-vapour,
(4) contains organic impurities,
(5) is raised in temperature.

Natural agents for purifying air.—(1) *Plants* as we have explained above, remove the carbon dioxide from the air and add oxygen to it during the daytime only.

(2) Every gas tends to fill all the space it can get and as the air is a mixture of gases, all its components tend to mix up together, and make the composition of the air uniform. This property of gases is known as *diffusion.*

(3) The wind also, even when so slight as to be imperceptible, serves the same purpose, by carrying the impurities away from the place of their origin and distributing them over a wider area.

(4) The oxygen in the air—especially when in the form of *ozone* — renders the organic impurities harmless by oxidizing them.

(5) The *rain* as it falls washes down most of the suspended impurities, and also removes many of the organic impurities and any harmful gases that may be in the air.

(6) Sunlight kills most pathogenic germs that may be present in the air.

Questions

1. Give the composition of the atmospheric air, and the properties of each constituent.
2. Describe the common impurities of air and their source.
3. What are the natural agents for purifying air and how do they act?
4. What test would you employ to find out if the air of a certain room is pure or not?
5. Give the composition of Inspired and Expired air. What constituents of the expired air are harmful?

CHAPTER III

VENTILATION

THE *object of ventilation* is the gradual removar or the products of respiration and combustion from our houses, by supplying fresh air. If we would only let fresh air into our houses, we should be far more healthy and far less prone to disease. Owing to the poverty and ignorance of the people, the housing conditions in our towns are simply appalling. Not only are houses crowded together back to back, in narrow lanes, but the construction of the houses of poorer classes is very defective. The rooms are close and dingy, with no proper inlets and outlets for the air, and more people live together in the same room than its size should permit. In case of the better class people, the rooms may have proper doors and windows; but through ignorance, very often these are kept shut; in summer for fear of heat and winter for fear of cold.

As we have learnt in the last chapter, there are two sources of carbonic acid gas in a room, viz. the breathing of the persons living in it, and the burning of fires, lamps, etc. The carbon dioxide given off in respiration is always accompanied by other organic impurities, and these are far more dangerous than the carbon dioxide. A much higher percentage of carbon dioxide could be permitted in a room and would not cause unhealthiness were it not accompanied by *organic impurities*. On account of these organic impurities, a relatively small increase of .02 per cent or two parts of carbon dioxide in 10,000 of air in a dwelling room makes the difference between pure and impure air. The amount of carbon dioxide in ordinary air being .04 per cent, it is generally held that its amount in the air of a dwelling room ought not to exceed .06 per cent. As a matter of fact this amount is very often exceeded in ordinary life, but in such cases the conditions are unhealthy. To persons whose sensibilities are dulled by constantly living in the vitiated atmosphere of ordinary overcrowded houses, the increase in the amount of this impure gas in the room is not perceptible.

The nose is a delicate instrument for indicating impurities in the air. Thus when we come from outside into a room, crowded by people, we at once feel it to be stuffy and hot. We should all train our noses to perform this important function, by living in the open air as much as possible.

Simple test of the purity of air.—As it is difficult to determine accurately the extent of organic impurity in the air, it is usual to estimate only the carbon dioxide in the air of a room and to take that as our standard for its purity.

Take a stoppered bottle with a capacity of 10 ozs. Fill it with water. Take it into the room the air of which is to be tested. Pour off the water in the room. Air from the room enters the bottle as the water flows out. Pour 1 oz. of clear lime water into the bottle, put in the stopper, and shake up. If the air in the room contains less than .06 per cent carbon dioxide the lime water will not turn milky.

Quantity of fresh air required.—A man breathing quietly gives off 6 cubic foot of carbon dioxide in an hour. Suppose one man is occupying a room containing 1,000 cubic feet of air. This air will contain .04 per cent, i.e., 0.4 cubic foot of carbon dioxide. To this will be added by the breathing of the 0.2 cubic foot of this gas in twenty minutes (for in an hour he gives off 0.6 cubic foot); in twenty minutes the room will contain $0.4+0.2$ cubic foot of carbon dioxide—0.6 cubic foot, or 0.06 per cent, the limit of maximum permissible impurity.

Thus in twenty minutes the air will have reached the border line between purity and impurity, and ought to be renewed. One man, therefore, needs 1,000 cubic feet of fresh air every twenty minutes, or 3,000 cubic feet every hour.

In cold climates, such that of England or certain parts of India in the cold season, the air of a room cannot be changed more than three times an hour without causing draughts, i.e. a sudden inflow of cold air from outside. This means that if we are to have 3,000 cubic feet of fresh air per hour, we must each have a cubic air space of 1,000 cubic feet, i.e. a space ten feet long, ten feet wide and ten feet high; but. though eminently desirable, this is much in excess of what most people are able to obtain. In the majority of rooms occupied by the poorer classes, the cubic space available for each person is often only 200 to 250 cubic feet, and there is frequent sickness among them as a natural consequence. Children require less cubic space than adults. In calculating the cubic space of a room, we must not forget to make due allowance for the number of oil lamps generally used. An ordinary kerosene oil lamp uses up as much air as one adult.

In buildings in which people gather together for cinema shows, etc., it is generally quite impossible to allow enough cubic space for the large number of persons assembling there. As a practical exercise, the student should calculate what must be the size of his classroom for the number of pupils occupying it, if the same amount of cubic space is allowed as in the dwelling rooms. Even if the expense of building such big rooms could be afforded, would the voice of the teacher be heard in all parts of such a room? Hence it should be obvious that in school rooms and other meeting places, the ventilation should be as free as possible, and all the doors, windows and ventilators should always be kept open. In County Council schools in London, it is insisted upon by regulation that a minimum allowance of 130 cubic feet per head be provided. The students should calculate if their own classroom fulfils these minimum requirements. In factories and workshops, 250 cubic feet of air space are required per head during the day, and 400 cubic feet during overtime. In hospitals the cubic space ought to be quite 1,500 cubic feet, and a minimum floor space of 100 sq. ft. per individual. This is in view of the fact that a sick person needs more fresh air than a healthy person, to enable him to get well. But in this country, it is quite a common though painful sight, to see a sick person confined to bed in a small room, not sufficient for his own needs, with his relatives who are attending on him and a number of 'kind' friends who have come to enquire after his health, in addition. These relatives and friends are actually robbing him of what he most needs, i.e. fresh air. Often, too, the doors and windows of the room are kept carefully shut, so that the air may not harm him, when in reality fresh air is a pressing necessity for him. Will the student ask himself what would be his obvious duty, if he ever found himself witness of such a scene?

The question of floor space is as important as cubic space and it must be clearly understood that cubic space is of no value when it is principally obtained by means of high roofs. For every individual, a floor area of ten feet (or 100 square feet) should be aimed at, and the height of the room should also be at least ten feet. In this way the 1,000 cubic feet of air space required would be obtained. In India, the height from floor to roof should be fifteen feet or more, to keep the rooms cool in summer, but for calculations of cubic air space available in the room, height above 12 feet should not be taken into consideration. Thus a room 16 feet long, 15 feet wide and 12 feet high, will contain necessary air space for $\left(\frac{16 \times 15 \times 12)}{1000}\right)$ or 3 individuals only.

Natural agents of ventilation.—The natural forces which act as the principal agents in ventilation are the diffusion of gases, the winds, and the movements of air due to differences in its temperature. The property of gaseous diffusion has already been referred to in the previous chapter. The air of rooms, being usually warmer and consequently lighter than the outside air, diffuses with considerable rapidity through cracks and openings, and even through porous materials such as bricks, mortar and mud. The interchange between the inside and the outside airs of rooms rapidly decreases, as the temperatures of the inside and the outside approximate to each other, so that in the hot weather, with the inside and outside temperatures nearly the same, even with the windows wide open, there is little or no exchange of air going on. Winds are very helpful to ventilation. They sweep impurities out of streets, houses and every place where they can enter. A strong wind may sometimes cause an epidemic of a disease to cease suddenly by sweeping away the stagnant air containing millions of germs of the disease; and by causing better ventilation of houses, streets, etc. The ventilating action of winds when they *flow freely*, through open doors and windows into a room is very useful but the action is greatly limited if a through current cannot be obtained, as in the narrow streets and lanes of our towns or when furniture, curtains, etc. block the way into the room. The wind also acts indirectly as a ventilating agent. As it passes over the tops of house chimneys, it produces a lowering of pressure in its neighbourhood and an up-draught is caused in the chinmey More air from below flows up to take the place of the air which has been sucked out, and so a current of air passes from the room up the chimney.

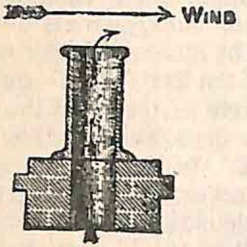

Fig. 4.—Draught up a chimney caused by wind blowing over its top. (*From Notter and Firth's Practical Domestic Hygiene.—Longmans.*)

The most important agent for ventilation is, however, found in the movements which are produced in the air by variations in its weight or density due to differences in its temperature. If a number of persons are sitting in a room, the heat given out by their breath and bodies heats the air, which, expands, gets lighter and rises towards the roof. Colder air flows in from the outside to take the place of the heated air. The hotter the air in the room becomes and the colder the outside air is, the quicker would be the mixing of the outer with the inner air. It is for this reason that when a fire is burning in the fire-place of a room, the ventilation is more thorough. The fire warms the air round about the chimney, it rises up and the colder air flows into the room through the door and windows to take its place.

Position of inlets and outlets.—It is important to remember that we cannot both let in the air and let it out by the same opening at the same time, unless the opening is very large; it is necessary, therefore, that for proper ventilation in a room, we should have at least two openings—an inlet to allow air to enter, and an outlet to allow air to escape. The foul air is usually much warmer than fresh air, and so it rises to the top of the room. Outlets, therefore, should be provided close to the ceiling. The sky-lights (*roshandan*) serve the double purpose of admitting light and serving as outlets for bad air. They should, therefore, be kept open. In most parts of India, doors and windows can be kept open day and night through the greater part of the year, without causing any discomfort and they serve as excellent inlets. There would be no risk of bad ventilation, if only they were kept open. In the severe cold weather, however, most people prefer to keep them closed, and special openings should be provided to serve as inlets. Theoretically, the best place for these would be near the floor, but in that case it is found that the cold air rushes in with a considerable force causing what is known as a draught. If an opening is made straight through a wall into the external air, above the heads of the people in the room (i.e. at about six feet from the floor), the cold air will pour in and fall down in a stream at a short distance from the opening (Fig. 5A), and, therefore, it is necessary to give the air coming into rooms from outside an upward direction (Fig. 5B), so that it shall come into the room like a fountain and not like a torrent.

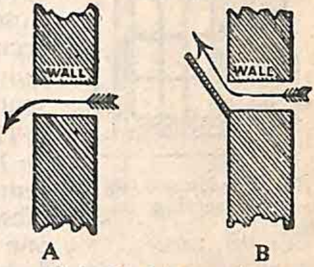

Fig. 5.—Air entering a room should be given an upward direction. *(From Corfield's Law of Health—Longmans.)*

When this is done the cold air coming in rises upwards getting gradually mixed with the warmed air, and becoming warmed itself, and so the temperature of the room is prevented from becoming either too hot or too cold, and the impure air is continually diluted with large quantities of pure air. The same object is gained by having the upper part of windows made so as to work on a hinge. By this means the top opens into the room (Fig. 6). This type of window is known in the Punjab as *tili wali khirki*. Numerous other devices are used in England and other Western countries. The inlets are commonly provided in England on a basis of at least twenty-four square inches for each person inhabiting the room, but in India the size of inlets and outlets should be thrice as much as that. In order to prevent draughts, there should be several small inlets and outlets, rather than one large inlet and one large outlet. Where no special inlets and outlets are provided, it cannot be too strongly insisted upon that even in cold weather all the doors and windows should not be closed up, and when the room is not occupied, all the doors and windows should be opened to get it well ventilated.

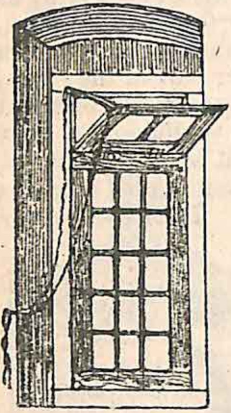

Fig. 6.—Hinged top of window serving as an inlet.

The houses of the poorer classes in India are generally very badly ventilated. A small *kothri* sometimes with less floor space than even one hundred square feet, serves as a dwelling room for the whole family. It has very often only one door opening into it, and the temptation to keep that closed at night is very strong. People should see to it, that quarters built for *chaprasis* and menial servants do not sin against the minimum hygienic requirements. Outlets for smoke or foul air must be provided.

In the hot weather.—In many parts of India, people sleep in the open air or on the tops of their houses, in the hot weather. Thus they escape from the evil effects of bad ventilation during a certain part of the year. But even in the open, it is desirable that beds are not spread too close to each other, or near the drains.

In the hot weather the air outside a room may not be much warmer than that inside it, and so there will be little or no change on its going in. It is thus all the more necessary that the room should be as large as possible and that the doors and windows be left open as much as possible.

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In mild weather all doors and windows should be kept open, day and night.

Artificial ventilation.—By this term is meant a method of ventilation, in which special *mechanical contrivances* are used either to *drive fresh air forcibly* into a room, or to *extract the foul air*, letting fresh air come in as best as it may, or both combined. There is no need to explain these methods further in this book, as it is only necessary to use them in large buildings, such as cinema halls; theatres, mines, mills, etc. It will be of interest for the student to know, that in the Houses of Parliament in London, such methods are employed, and fresh air is forced through tubes to enter the basement, where it is washed or filtered through screens of moistened canvas (to get rid of suspended impurities), then passed over steam pipes, by which it is heated, and next conducted by shafts to spaces beneath the floors and benches of the rooms. The vitiated air ascends to openings in the ceiling and is thence conducted by a shaft to the basement of the clock-tower, where the flue of a furnace furnishes a powerful up-exhaust. By this means air can be delivered in sufficient quantity, freed from suspended matters, and warm or cold, dry or moist, according to requirements. This is further described in the paragraph on Air Conditioning in the chapter on 'The House'.

Effects of bad ventilation.—There is a real danger in living in an overcrowded room.

Temporary overcrowding, such as attending an overcrowded public meeting, or a cinema show, or travelling in an overcrowded compartment of a railway train may cause headache, giddiness, fainting, and even vomiting and diarrhoea. If the overcrowding is extremely great, death may result.

If the exposure to foul air is prolonged from day to day, as in the case of persons living in overcrowded and badly ventilated rooms, the general health becomes impaired and the tendency to catch infectious diseases is greatly increased. The person becomes pale and anaemic and often suffers from sleeplessness, want of appetite, indigestion, and a feeling of languor and unhappiness. He is unable to make prolonged efforts of mind or body.

Proper breathing habits.—The nose is the proper inlet for the air to be taken into the lungs and not the mouth. When air passes through the nose it is warmed and moistened, through contact with the blood-capillaries in the mucous membrane of the nose, and particles of soot, etc., suspended in the air are also kept out. Breathing through the mouth must therefore be avoided.

The adoption of a stooping posture in sitting or walking cramps the chest and does not afford free play to the lungs. Therefore always stand and walk erect with the shoulders thrown well back.

In ordinary breathing we do not expand the lungs to their full extent, nor do we empty them completely. The more completely the air in the lungs is changed, the better will be the resulting aeration of the lungs. It is good therefore to cultivate the habit of deep breathing for a few minutes every morning and evening and as often as possible during the day. Exercise also promotes rapid and thorough breathing and circulation of the blood. Exercise should always be taken in the open air, so that plenty of fresh air may enter the system.

Questions

1. Why is fresh air essential for health?
2. Describe simple tests for the purity of air.
3. What is the amount of air space necessary for an individual, and how is it calculated?
4. Define ventilation and describe the natural agents of ventilation.
5. Give the position of inlets and outlets in artificial ventilation, giving reasons.
6. Explain the evil effects of bad ventilation.
7. Describe proper breathing habits.

CHAPTER IV

WATER AND ITS SUPPLY

Water is one of the first necessities of life. It enters very largely into the composition of our body. Not only do we drink it, but it also forms an essential part of all kinds of food that we eat. It is due to the solvent action of water that our daily food is so changed and dissolved that the nutritive parts can be taken up by the blood, and repair the waste always going on in our bodies. Apart from supplying the direct needs of the body, water is required for cooking and washing purposes. This importance of good water for drinking purposes is generally admitted, but in practice, few people take any special care about the water they use. Water should be considered fit for drinking if it is clear, colourless, odourless, sparkling, fresh and not insipid to the taste, neither saltish nor sweet, has no suspended particles in it, deposits no sediment on standing, and is free from contamination with disease germs. Turbid or saltish water must always be looked upon with suspicion. Chemically pure or distilled water contains nothing dissolved in it. Water, as every student of science knows, is a chemical compound, formed by the union of two volumes of hydrogen and one of oxygen. On account of its great solvent properties, water is, however, never found in a chemically pure condition in nature. But it can be regarded as sufficiently pure for hygienic purposes, if any substances dissolved in it are present only in very small quantities and do not produce any injurious effect on health.

Quantity of water required.—The amount of water required for domestic use varies with the habits and standard of living of the people. From the health point of view one should encourage the free use of water and yet prevent waste. On an average 40 gallons of water are required per head per day excluding the quantity required for water closets, etc.

Impurities in water.—The impurities in water may be either suspended or dissolved. Suspended impurities will usually settle at the bottom, if the water is allowed to stand, or they may be removed by filtration. Dissolved impurities are left behind if water is distilled off.

Suspended impurities may consist of (*a*) merely fine particles of sand or minute fragments of wood, etc., which do not cause disease, but may set up diarrhoea by causing mechanical irritation of the bowels, (*b*) disease germs such as those of cholera and typhoid fever which are invisible to the naked eye, or (*c*) eggs of parasitic worms, such as round-worms, thread-worms, etc., which when taken into the body develop into adult worms, suck up nourishment and produce harmful symptoms.

The substances that water may contain in solution are (*a*) mineral salts, derived from the soil through which the water percolates, and (*b*) organic matter of vegetable or animal origin and the products of its decomposition such as salts of ammonia, nitrates, nitrites, etc. Of the mineral salts contained in water, carbonate of lime (calcium carbonate) is of most common occurrence, and is held in solution in water, by the aid of free carbonic acid gas, which most natural waters contain. The presence of this salt in moderate quantity in water does not render it injurious. Then come other salts of calcium, such as sulphate, nitrate, and chloride of calcium. These, as well as sulphate and chloride of magnesium; are soluble in water without the aid of carbonic acid gas. All these salts have injurious effects and render the water liable to produce disturbances of the digestive system in persons who drink it. Water containing carbonates and sulphates of calcium or magnesium is called *Hard*. It is not suitable for washing, as it forms curds instead of lather with soap. Hardness due to carbonates is called *temporary* as it is removed by boiling, but that due to sulphates is not removed by boiling and is thus *permanent*.

Common salt (*sodium cnloride*) frequently occurs in small quantities in natural fresh water, and may occur in much larger quantities in water derived from wells near the sea-shore or sunk in salt-bearing rocks. Except when formed under these circumstances, even small quantities of salt should be looked upon with suspicion, indicating probable contamination of the water with animal refuse, derived by percolation from a sewer or cesspool.

Salts of ammonia are present in very minute quantities in all natural waters, even in rain water, but their presence in anything but in very small quantities (except in deep well waters) is owing to the presence of decomposing organic matters, and ought to be regarded as an impurity. Nitrates, especially the nitrate of ammonia, are found in small quantities in certain waters, but they are frequently formed in waters by the oxidiation of nitrogenous organic substances, and should be regarded with suspicion. The presence of organic impurities in water may be tested by the addition of a sufficient quantity of a solution of potassium permanganate to the water to give it a bright pink colour, and by letting it stand in a covered glass vessel for some hours. If organic impurities are present, the colour of the liquid will fade; the greater the loss of colour, the greater is the amount of organic matter present.

Effects of drinking impure water.—The effect of drinking water in which there are suspended impurities or mineral salts in solution (such as an excess of lime or magnesium salts) has been referred to in the preceding paragraph. More dangerous is the presence of decomposing organic matter, whether in solution or in suspension. When water polluted by sewage or drainage from a graveyard is drunk, the result is frequently diarrhoea, or if the organic matter contains the specific germs, dysentery, cholera, or typhoid fever. In India there is a very real danger of animal or vegetable refuse getting into water. Springs, rivers and streams, tanks and wells are all liable to serious contamination from this source owing to the dirty habits of ignorant people. The following denunciation by Dr. Bedford is none too strong: 'Suppose that a man who has just recovered from cholera bathes in a tank—what is the result? He poisons the water by spitting into it; and he washes his body, which may be soiled with dried portions of fæces which are full of cholera poison (germs). Other people swallow these particles and get cholera.'

'Again people in many cases use the banks of tanks as a convenient place for emptying their bowels. What is the result? The next shower of rain washes the motions into the tank. Again cattle are watered and washed; filthy cooking pots, grain, fruit and worse than all, filthy clothes are washed in the tanks. The pots, cattle, grain and fruit make the water foul and such dirty water causes diarrhoea and other worse troubles. But dirty clothes are most dangerous of all. Suppose a man has been suffering from dysentery or cholera, and his clothes are fouled with fæces. The linen is then washed in the water which is thus poisoned with the particles of fæces washed off the clothes.'

Not only the tanks, but rivers and streams, springs and wells are all defiled in this abominable fashion. The discharges of persons suffering from cholera or typhoid fever are often washed down the drains, and percolating through defective drains or through leaky cesspools, privies, etc., obtain access to the water of the wells, or are even poured direct into streams or rivers, from which drinking water is taken. No wonder that cholera and typhoid claim such a large number of victims every year in this country.

Sources of water supply.—All the water we get, whether from springs, wells, ponds, or rivers, is originally derived from the rain which falls upon the ground. As everyone knows, water is constantly evaporating from the surface of the sea and from the land, under the influence of the sun's rays; it forms clouds by being separated from the air, and descends, as the result of changes of temperature, in the form of rain, dew, mist, snow and hail. Part of this water is again evaporated, part flows off the surface of the ground, and helps to swell the brooks and streams which form rivers, a certain amount goes directly to the seas or lakes. Another part sinks into the soil and passing through various porous strata or through fissures in the rocks, is held underground, and supplies our wells or reappears again in the form of springs. A certain amount is utilized in the processes of growth of animal and vegetable life.

1. *Rain water.*—This, while it is falling, is the purest form of natural water, but it becomes tainted by the atmosphere through which it passes and the surface on which it falls. In certain hill districts, rain is carefully collected from all possible receiving surfaces, and is used for all pur-

poses. In the plains rainfall is so infrequent, and in towns and villages the atmosphere and the receiving surfaces are so impure, that the water would dissolve those impurities and so be unfit for drinking purposes.

2. *Upland surface water.*—As mentioned above, a certain amount of the rain that falls on the ground, passes through the soil and dissolves various impurities depending on the nature of the soil through which it passes. If the water does not dissolve much of these substances, and only passes through soil which is at a higher level than houses or cultivated land, it is described as upland surface water. It is generally quite safe and may be collected in a well or drawn from a spring. Such water is collected from the hills in natural or artificial lakes, carefully guarded from all sources of pollution, and brought by long conduits to the towns situated on the lower levels.

3. *Springs.*—Part of the rain water soaking into the ground sinks through the upper or pervious layer of soil until it reaches an impervious layer (a layer of clay, for example), The water cannot pass through the layer, and so it runs along the top of it, forming an underground collection, called sub-soil water or ground water. Fig. 7 shows the holding up of the ground water by an impermeable layer of clay. Where the impervious layer reaches the surface, commonly at the foot of a hill or in a valley,

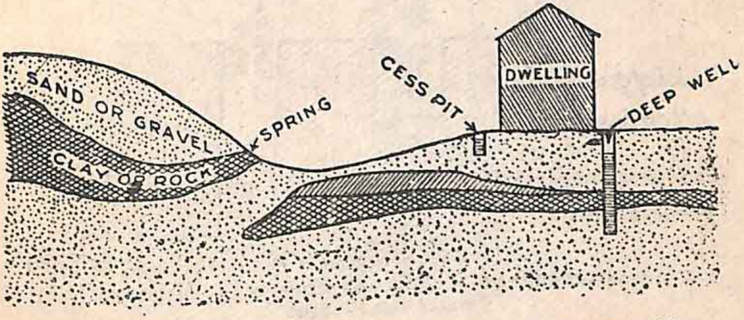

Fig. 7.—The holding up of ground water by an impermeable layer of clay. (*From Notter and Firth's Practical Domestic Hygiene.—Longmans.*)

springs are formed. The layer of clay is in the form of a shallow cup in which water collects until it overflows the edge, and the water appears on the surface as a spring. During dry seasons, owing to little water soaking into the ground, springs are apt to run dry.

The water from springs is usually of excellent quality but often it is hard, owing to the presence of lime derived from the layers of soil through which the water has percolated.

4. *Wells.*—Wells are the chief source of water-supply in most towns and villages in India. Wells are either shallow or deep. *Shallow* or surface wells are made by digging down from the surface of the ground to below the level of the subsoil water. The depth at which the subsoil water is found varies in different places with the character of the soil and the amount of the rainfall, etc. These wells may yield considerable quantities of good water, but as the water from the soil all round them for some distance, percolates into them, the water they contain is very frequently (especially when they are near houses or cultivated fields) rendered impure, as foul refuse matters—the leakage of drains, cesspools, or manured fields—find their way into it and contaminate it. The danger from such wells is specially great during the rainy season when the level of the subsoil water rises. A sudden rise in the level of the subsoil water may sometimes cause sewage matter to be carried direct

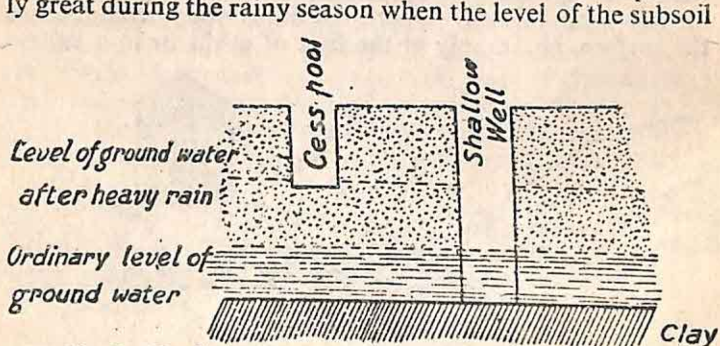
Cess pool
Shallow Well
Level of ground water after heavy rain
Ordinary level of ground water
Clay

Fig. 8.—Fouling of shallow well water by rise of ground water due to rains.

from a cesspool to a well. The effect of such pollution would be to spread such diseases as cholera, dysentery and typhoid.

To get rid of all such dangers, *deep* wells are sunk. Fig. 7 shows a well sunk sufficiently deep to go through and below an impermeable layer of clay, which enables it not only to tap the water below the clay, but protects it from drawing on the water lying in the surface soil above the clay layer.

Wells being such a common source of water supply, it would be well to emphasize a few points to which special attention should be paid in their construction and use:

(1) A good well should be lined with brick work and the inner surface of the bricks covered with cement, down to the water line, or in the case of a deep well, down to the level of the impervious layer of soil which it pierces. The object of this lining is to prevent organic matter from the neighbourhood soaking into the well.

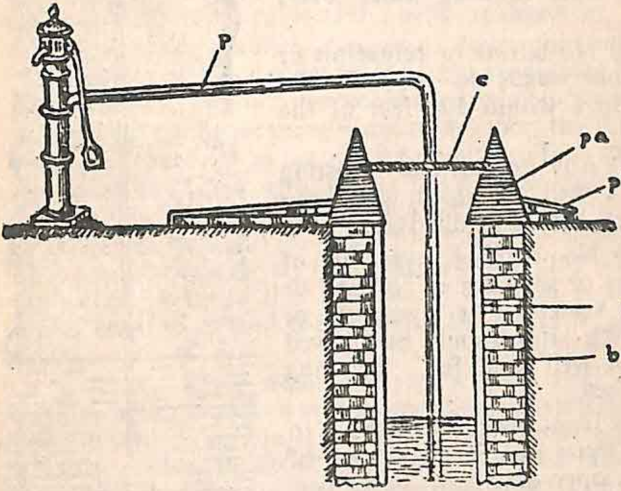

Fig. 9.—A good well. *b.w.*—brickwork; *c.*—cover; *c.l.*—cement lining; *p.*—pipe; *pa* —parapet; *pt.*—platform. (*Slightly modified from Bedford's Elementary Hygiene.—S.K. Lahiri & Co.*)

(2) There should be a masonry parapet wall rising a few feet above the mouth of the well. This wall should have a pointed top, to prevent people from sitting on it.

(3) There should be a sloping pucca platform round the mouth of the well, and also a pucca drain to lead off water from this platform.

(4) The mouth of the well must always be kept closed, so that dust, dry leaves or other vegetable or animal matter may not fall into it. The best plan is to have a pipe going down into the well. This pipe leads to a pump placed at a little distance from the well mouth. The well is then always kept closed, the pipe passing through the cover. But if a pump and pipe are not provided, it should be possible to close the cover after drawing water every time.

(5) No latrine or refuse-pit or cesspool ought to be allowed anywhere within 100 feet of the well.

(6) Any depressions existing near a well, in which water can collect, should be filled up.

(7) No bathing, washing of clothes or washing of cooking or other vessels, or washing or watering cattle should be allowed near a well used for drinking purposes.

(8) If a bucket is used to draw water out, it should be of metal, open zinc *baltis* being perhaps the best of all. Leathern buckets should be discarded, as they cannot be kept clean.

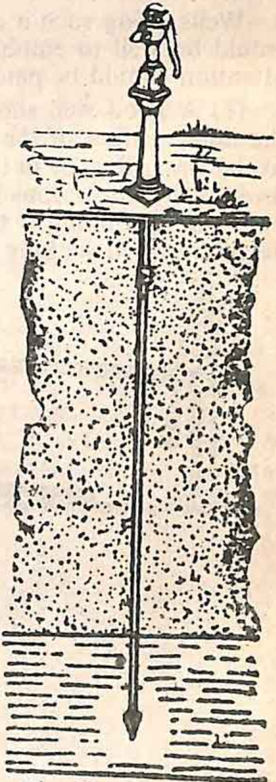

Fig. 10.—A tube well, (*From Notter and Firth's Practical Domestic Hygiene —Longmans.*)

Chains are better than ropes which easily get dirty. It is a bad practice to scrub a metal utensil with earth or ashes, and then to lower it into the well to get washed and filled with water. In the event of cholera breaking out in any locality, it would be a good plan to pay a man from public funds to draw water from the well by means of a clean bucket and to pour it out into the vessels of those who come to take water from the well. At such a time private *ghurrahs* or *lotahs* should not be allowed to be lowered into the well.

To those who are accustomed to let things drift as they may, some of the points mentioned above may appear to involve needless expense or inconvenience, but it must be remembered that it is comparatively slight mistakes on the part of a few ignorant people which lead to severe outbreaks of cholera, and if we are not willing to adopt better and safer means, we must be prepared to pay the penalty in the form of disease. Students of hygiene would do well to inspect one or two wells in their neighbourhood and report to their teacher in what respects the wells are defective.

Many of the possible chances of direct contamination of a well can be avoided by having what are known as tube wells. A tube well is constructed by driving tubes into the soil, one length being screwed on to another, the first tube being perforated at the bottom for about two feet, its lower end being furnished with a steel point; when the sub-soil water is reached, a pump is attached to the tube. Tube wells are preferable to the type of well usually constructed. They are used extensively in the larger towns all over India. Care must be taken that the tube is sunk to a sufficient depth, and the ground round about the pump is properly paved.

5. *Rivers*—River water contains a good deal of suspended matter, and as a rule more organic matter than the water of wells or springs. If the supply is taken from a river before it reaches inhabited places or cultivated lands, it is generally pure, Sewage and other impurities from towns and villages on its banks are added to it, and it is not advisable to use river water for drinking purposes unless it is filtered and boiled. The rivers, however, possess a self-

purifying action, and some miles further down from any town on its bank, the water of a river may be found to have got rid of its impurities. This purification is chiefly brought about through the oxidation of the impurities by the oxygen in the air and the absorption of the organic impurities by fish and other kinds of animal and plant life inhabiting the river; much of the solid matter also settles down to the bottom.

It is an interesting fact to note that at Hardwar where millions of Hindu pilgrims congregate every year, to bathe in the sacred Ganges, the pilgrims use the river water, and the Pandas (Brahman priests) and others permanently settled there, as a rule, use well water for drinking purposes. The pilgrims suffer from cholera and spread it all over the country.

6. *Lakes.*—Lakes are natural collections of upland surface water, and being generally situated in sparsely-inhabited areas, are less liable to contamination. They afford a very good source of municipal water-supply for the towns in the neighbourhood.

The following table taken from the River Pollution Commissioner's Report published in England will be found useful:

Wholesome	1. Spring water 2. Deep well water 3. Upland surface water	Very Palatable
Suspicious	4. Stored rain water 5. Surface water from cultivated lands	Moderately Palatable
Dangerous	6. River water to which sewage gains access 7. Shallow well water	Palatable

Water supply in Towns.—In large towns a pipe water supply under the control of the municipality is necessary. The best source for such a public supply is either a large lake, or else upland surface water collected in large artificial lakes. In the plains the supply is generally obtained from a number of wells sunk far off from the town. These are now being replaced by electric tube wells, wherever electricity is available. The water is pumped up and stored in a reservoir constructed near the town and as high as possible. From this reservoir water is taken away by underground mains, and is distributed through pipes to the houses. Unless the water is pure, it is generally purified by passing through settling and filtering tanks, into the construction and action of which it is unnecessary to enter here. It is sufficient to mention, however, that a public supply, being under the control of trained and responsible officers, is generally far safer than water obtained from ordinary wells, and since the introduction of water supply in many of our large towns the prevalence of epidemics of cholera has been greatly checked.

The water may be supplied on the constant supply system, that is, the pipes are always filled with water, so that water may be obtained at any time by turning on the tap. Or, the water is supplied at certain hours every day. This is called an intermittent supply. Of these, the constant supply system is more preferable from every point of view.

Storage of water —Water may be rendered impure and dangerous during transit from a well or the public standpost in the street of the house, by contamination from the person carrying the water or from unclean water vessels. The use of leathern buckets and water-skins (*mashak*) so extensively used for drawing and carrying water must be considered objectionable; also the use of very large earthen receptacles (*mat*) for storing drinking water in the house, as these are hardly ever cleaned. Metal utensils, such as zinc buckets and copper or brass vessels (*gagar*), are good to use. If earthen *ghurrahs* or chatties are used, they should preferably be glazed and kept perfectly clean. Ordinary *ghurrahs* and *surahis* should be discarded after use for a few weeks and new ones obtained.

Purification of water.—Pipe water supplied to a town should be such as not to require any further purification on the part of individuals using it. Still, in places where there is no public water-supply or when an epidemic of cholera is raging, it may be necessary to purify it before use. There are four possible methods, namely boiling, distillation, filtration, or by the use of germicidal substances.

By *boiling* the water any disease germs that may be present are destroyed. But in order that this method may be quite effective, water must be kept boiling for at least fifteen minutes, and then allowed to cool and kept in carefully cleaned and covered vessels. As the air dissolved in ordinary water gets driven out by boiling it, the taste of boiled water is flat and insipid. It may be rendered pleasanter to drink by pouring it backwards and forwards from one clean vessel into another, several times so as to mix it with the air.

Distillation would remove all suspended as well as dissolved impurities, but in practice it is never used for domestic purposes on account of the trouble and expense involved.

Filtration. as ordinarily carried on, is practically of no use. Various filters have been devised for domestic purposes. The best is the Pasteur-Chamberlain filter. This consists of an outer glazed earthenware vessel or tube which is connected with an ordinary water-tap, so that the water is forced under pressure through the pores of the inner tube which is made of fine unglazed porcelain. These pores are so fine that bacteria are unable to pass through them, though viruses can do so. In the Berkefeld filters the inner tube is made of a finely porous special earth, and filtration is more rapid. In both kinds, the inner tube can be removed and ought to be thoroughly cleaned at least once every week.

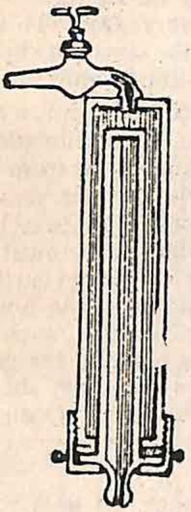

Fig. 11.—Pasteur-Chamberlain Filter. (*From Notter and Firth's Practical Domestic Hygiene, Longmans.*)

For filtration on a large scale as in municipal water supplies, sand filtration is generally used. In *slow* sand filtration water is passed in open tanks which have a layer of 3 or 4 feet of sand at the bottom. Through this layer water slowly percolates and is collected into covered reservoirs. In *rapid* or *mechanical* sand filtration a coagulant like alum is added to the water which is then rapidly passed through sand either by pressure or by the action of gravity. The rate of flow is about fifty times greater than in slow filtration.

The *germicidal substance* commonly employed for purification of water is Chlorine. Chlorine is often used for purifying collections of water for troops; and is added extensively to municipal water supplies in large towns. It can easily be employed for domestic purposes as well. Chlorine is prepared by adding 1/2 oz. of chloride of lime to 1000 gallons of water, and is one of the simplest and most efficient agents.

Cleaning of wells.—All wells should be periodically cleaned. This is best done in the hot weather, when there is least water in the well. The rubbish at the bottom of the well should be removed and as much of water drawn out as possible.

Whenever there is much organic impurity in the water, as evidenced by its colour and smell, the well should be treated with chlorine. Also, whenever there is any case of cholera, all the wells in the locality should be disinfected with this substance.

Questions

1. Give the properties of pure water and describe its common uses.
2. Describe the common impurities in water and how you will remove them.
3. Discuss the effects of drinking impure water.
4. What are the different sources of water-supply? And discuss their relative importance.
5. Discuss the various methods of purifying water,
6. Name the diseases caused by drinking contaminated water.
7. Mention the different varieties of wells.
8. Describe the essentials of a hygienic well.
9. Describe the impurities in well water, their source and methods of purifying the water.

10. Describe the various methods of filtration of water. Discuss the advantages and disadvantages of Pasteur-Chamberlain filter.
11. Define *hard* and *soft* waters.

CHAPTER V

FOODS

Necessity for food.—Everyone knows how necessary it is for us to take food. Our body is constantly doing work. Even when we are asleep, the body is doing some work. The body is kept warm, the heart keeps beating, and breathing as well as many other actions and processes of which we are unconscious are going on in our body. This is internal work. The external work consist of all our voluntary acts, such as standing, walking, running, talking, etc. Various waste matters are produced as the result. The lungs give off carbon dioxide and water vapour, the kidneys get rid of water containing waste nitrogenous substances in solution, the skin chiefly throws out water with a very small amount of substances dissolved in it as sweat. All the tissues of the body are constantly breaking down. It is to make good the loss which the body is continuously undergoing, to warm it, and to supply the energy necessary for both the external and internal work of our body, that we take food. In addition to all this, part of the food which young children eat goes to form the growing parts of the body.

The human body is often compared to a steam engine. Just as there is in the engine the metal framework and the coal that heats the water placed in the boiler of the engine into steam, which sets the metal machine in motion, so there is in the body the skeleton or bony framework moved by muscles which are set in action by the brain and nerves, which themselves obtain their energy from the food we eat In both mechanisms, carbon and hydrogen are burnt, and stored up or potential energy converted into actual energy and heat. From both engine and body, carbon dioxide and steam escape, and unburnt or unused waste is thrown out. Here the comparison stops, as the engine is not built or repaired by the coal supplied to it, whilst the body is built from and kept in a state of constant repair by the food we take. The body assimilates the food and grows at its expense. Many other differences between the engine and the body will suggest themselves to the student, but here only those relating to food and work are referred to.

Classification of Food-stuffs.—Our diet contains certain substances known as proximal principles, every one of which is essential for the maintenance of life and health. These substances may be classified as follows:

(1) Proteins	**Body builders**
(2) Salts	
(3) Fats	**Energy producers**
(4) Carbohydrates	
(5) Water	**Necessary for health**
(6) Vitamins	

Any article of food that you take would contain one or more of these food-stuffs. The relative proportion of some of the proximal principles in certain articles of daily use is represented in Fig. 16, p. 50.

(1) *Proteins.*—A large amount of nitrogen in the form of urea, uric acid and other substances is daily lost from our body in the urine, and to repair this loss as well as for growth, a daily intake of nitrogenous food is necessary. The only form of nitrogenous food which the body can make use of is that known as *protein*, the literal meaning of which is 'I am the first', that is, the most important. Proteins are composed of carbon, hydrogen, oxygen, nitrogen and sulphur, with occasionally a little phosphorous. As an example of a protein may be mentioned the white of an egg or *albumen*. There is *myosin* in meat, *glutenin* in wheat flour, *fibrin* in blood, *casein* in milk, curd, and cheese, and *legumin* in peas, beans and various lentils (dals). The first three of these, namely albumen, myosin, and glutenin are coagulated by heat. As the result of digestion in the stomach

and small intestines proteins are changed into substances called peptones and amino-acids. Owing to different proteins being composed of varying quantities of different amino-acids, proteins differ in their value. Animal proteins are of greater value, and vegetarians should take abundant quantities of milk and milk products to make up the deficiency. Proteins from animal sources are regarded as first class proteins, and those of vegetable origin as second class.

Percentage of Protein in Certain Foods

Animal foods	Protein (per cent)	Vegetable foods	Protein (per cent)
Cheese ..	28	Lentils ..	24
Mutton ..	18	Peas ..	22
Fish	12 to 14	Oatmeal ..	13
Eggs ..	13	Bread ..	8
Milk ..	3 to 5		

The *use* of *proteins* is to build the tissues of the body and to repair these when worn out. Proteins are, therefore, absolutely necessary for the existence and growth of all animals. If taken in excess they may be a source of some of the fat of the body and of the glycogen found in the liver and muscles. They also help in the production of animal heat.

(2) *Mineral Salts.*—These are the second class of building materials of the body and form about one twenty-fifth part of the whole body. The most important of these is common salt (Sodium Chloride), which is taken not merely to give taste to food, but to supply a need of the body. It is contained in all the tissues, and is an essential constituent of the blood. It is the source of the hydrochloric acid present in the gastric juice of the stomach. Other important salts are the phosphates, especially that of calcium, which are required particularly for the bones and teeth—we get these in small quantities

in many of our foods, but chiefly in eggs and milk. Salts of potash are contained in the blood and in most of the tissues, and are supplied to us chiefly in the vegetables we eat. Salts of iron are also an absolute necessity of life, as iron forms an important constituent of the hæmoglobin of the red blood corpuscles. Salts of iron are present in small quantities in almost all our foods. Iodine is also needed by the body. Too little iodine in the food is one of the causes of the swelling of the thyroid gland in the neck, called Goitre. Many other mineral salts are contained in our foods, but need not be especially referred to.

(3) *Fats.*—These consist of carbon, hydrogen and oxygen and are derived from both the animal and vegetable kingdoms. Butter, *ghee*, and various vegetable oils like mustard oil or coconut oil are all examples of fats that are used as food.

The *use of fats* is to produce heat and energy, by the oxidation of the carbon and hydrogen into carbon dioxide and water. They also repair or renew the fatty tissues and help in the proper digestion of other foods. As a general rule, for people doing hard work or living in cold climates, an increase of fatty food is required.

(4) *Carbohydrates.*—These include all the various starches and sugars. They are composed of carbon, hydrogen and oxygen, the last two being present in the same proportion as in water. Hence, their name 'carbohydrates'. In the main, the carbohydrates are derived from the vegetable world, thus starch is found in the grains of all cereals, such as wheat, maize, oats, rice and potatoes. Cane-sugar is obtained from the sugar-cane and beetroot. Grape-sugar is present in grape juice; lactose, a kind of sugar, is found in milk and glycogen a form of starch, exists in the liver.

The *use of carbohydrates* is similar to that of fats. They are used for maintaining animal heat and the production of energy by their oxidation, and the formation of new fatty tissues. It would seem, therefore, that they could take the place of fats in a diet. Carbohydrates being much cheaper than fats, poor people have to depend largely on them, but it has been shown that health cannot be properly maintained if fats are entirely excluded. For the complete combustion of fat in the body, carbohydrates must be burnt along with it, just as in an ordinary lamp, both the wick and the oil must burn properly. For a good diet proteins, fats, carbohydrates, salts, water and vitamins should all be present.

(5) *Water.*—Water is contained in all the tissues. About two-thirds of the weight of the body consists of it. In the body, water serves to dissolve the foods when digested and aids in their absorption, maintains the fluidity of the blood, and assists in the removal of waste matters from the body. Water is separated from the blood continually by all the excretory organs, an average person losing from 3½ to 5 pints of water per day from the skin, lungs, kidneys and intestines. This must be replaced in the food. Usually one-third of this amount is obtained in taking solid food, leaving about three pints of water to be drunk per day. Water stands second only to oxygen among the necessities of life.

(6) *Vitamins.*—It has long been known that feeding animals only with sufficient quantities of pure proteins, fats, carbohydrates, salts and water, does not maintain them in a healthy condition. Such experiments on the feeding of animals led to the discovery of certain substances which must be included in food in order to maintain life. These substances are called *Vitamins* (lit. life-giving substances), and a vitamin-free diet gives rise to certain diseases, generally known as deficiency diseases, and may even cause death. Vitamins are present in all kinds of food, and most are destroyed by the heat or long keeping. Eight kinds of important vitamins have been recognised.

Fat-soluble A Vitamin, present in certain fats, particularly cod-liver oil, butter, cream, cow's milk, yolk of eggs and in green leaves and certain yellow vegetables, such as carrots. It is, however, absent from lard and fats of vegetable origin. Vitamin A is the general health vitamin, as it increases the resistance of the body to infection, and tones up the whole system. It helps to ensure good appetite and digestion, promotes growth, and makes for long life. It also helps to prevent infections, particularly of the eyes, throat and respiratory system. Its deficiency causes night blindness, disorders of skin, stunted growth and respiratory diseases. Boiling does not kill it, but in drying (e.g. powder milk) it is destroyed. It is manufactured from carotine (yellow susbstance of leafy vegetables and carrots) by the liver, and is stored in it.

Water-soluble Vitamin B Complex.—It includes a number of vitamins, all soluble in water and not destroyed by heat. They are very intimately associated in occurrence, as well as in function. It is, therefore, doubtful if deficiency of any single vitamin B factor ever occurs, and, therefore, in treatment all the vitamins comprising B Complex are given together. But certain symptoms are more marked in deficiency of any particular B Complex factor, and, therefore, that particular B Complex factor is given in large doses. Some of the vitamins comprising B Complex have been isolated from natural sources and others prepared synthetically.

Vitamin B_1 *(Aneurin Thiamine)* is present in germinating seeds, yolk of .eggs, yeast, green vegetables, cereals like wheat and rice, and in fresh peas and beans. In the case of cereals it is present just under the skin and is removed in the process of milling. Vitamin B_1 is the nerve vitamin. It protects the body from nerve diseases, like Beri Beri. Like Vitamin A, it also acts as a stimulant to the appetite and digestion and as a growth factor.

Vitamin B_2 *(Riboflavin)* is abundant in milk, eggs, liver, green vegetables, tomatoes and in fruits like apricots and mangoes. Its deficiency results in soreness of angles of the mouth, nose, tongue, lips and eyes.

Vitamin B_6 *(Pyridozine).*—It is synthesized in the intestines and its natural sources are cereal grains, legumes, rice, polishings, yeast, liver, egg yolk, meat and fish. Signs of its deficiency are inflammation of tongue, mouth and skin near the eyes, nose and mouth.

Its deficiency is associated with deficiency of other members of B Complex and it helps nicotinic acid and in curing Pellagra.

Nicotinic Acid, Niacin and Nicotinamide.—Deficiency signs of these are seen in skin, alimentary canal and nervous system such as in the disease called Pellagra. Hence it is called Pellagra Vitamin.

Panthothenic Acid.—Its deficiency causes retarded growth, sterility, gastro intestinal and nervous disturbances, greying of the hair and burning sensation in hands and feet.

Vitamin B_{12} is present in liver, yeast, cereals and pulses and *Folic Acid* in liver and green vegetables. They are also necessary for blood formation and their deficiency causes pernicious anaemia.

Water-soluble C-Vitamin is present in most juicy fruits especially lemons, oranges, etc., and in vegetables especially cabbage, tomatoes and turnips. Vitamin C is required to promote the normal formation of the teeth, to ensure the health of the teeth and the bones, and to proteet the body against scurvy, and help wound healing, blood formation, recovery from illness and resistance to infection. It is destroyed by heat, alkalis and by drying.

Fat-soluble D-Vitamin is abundant in cod-liver oil and also occurs in milk, butter, ghee, yolk of eggs and liver. It has the property of preventing rickets by causing normal bone growth, and preventing defective calcification in teeth. It is naturally formed by the action of Sun on the skin and hence the name 'Sunshine Vitamin'.

Fat-soluble E-Vitamin is found in oil contained in the germs of cereals (e.g. wheat) and in certain green leafy vegetables. It has a vital influence on the organs of production, and its absence leads to sterility.

Fat-soluble K-Vitamin is found in cabbage, spinach, tomatoes, etc. It helps in coagulation of blood and hence called 'Coagulation Vitamin.'

Each of these distinct kinds of vitamins must be supplied in our diet to keep the body healthy, and their absence from our food leads to certain diseases. Rickets is associated with a lack of D-Vitamin, Beri-Beri with a diet poor in B-Vitamin, and Scurvy with absence of C-Vitamin. Scurvy used to be very common amongst sailors in long voyages but is rarely met with now as lime juice is regularly served, whenever there is a shortage of fresh vegetables and fruits. If a reasonably varied diet with fresh vegetables or fruits be taken, there is no need to worry about vitamins as they will have been adequately supplied.

Food Accessories.—These include such substances as tea, coffee, cocoa, alcohol, as well as pepper, chillies, and other condiments.

The condiments are substances which are added to the food with the object of making it more tasty and palatable, thereby stimulating the digestive apparatus. Among them are included mustard, pepper, chillies, nutmeg, cloves, ginger, mint, vinegar, lemon-juice, etc. *Chutnies* and *achar* also come under this head. In small quantities all these things help digestion, but taken in excess they are very injurious.

Pan or betel leaf.—The habit of chewing *pan* is very widespread in this country. *Pan* is the leaf of a creeper. It is either chewed raw or lime and *katha* are smeared on it and small pieces of *Supari*, *Ilachi*, *Long* (cloves), etc, chewed along with the *pan* leaf. The chewing produces lot of saliva which helps the digestion of starch if *pan* is taken immediately after meals. If, however, *pans* are chewed constantly, gums are liable to decay and teeth get loose. Mouth must be thoroughly rinsed out some time after taking *pan* and teeth brushed twice a day, in the morning and at bed time.

The effects of the various alcoholic liquors, and of tea, coffee, and cocoa, will be fully considered in the next chapter.

Articles of food.—We must now examine some of the most important foods, and see what they are composed of. The vitamin contents of these foods have already been given and need not be repeated.

Milk.—It may be regarded as an emulsion of fat with water containing proteins and carbohydrates in solution. It is a perfect food, inasmuch as it contains in itself all the proximal principles of food in a proportion necessary for health and growth. It is the sole food on which the human child and the young ones of all other mammals (the animals which suckle their young ones) depend entirely during a longer or shorter period of their early life. A glance at Fig. 12 will show the relative proportion of all the food substances in a glass of milk.

The milk of various animals differs somewhat in composition, but it always contains (1) proteins, mainly casein and a little albumen, (2) fats which are suspended in the water in the form of very fine particles, and separable as cream or butter, (3) carbohydrates, in the form of lactose or milk-sugar, (4) mineral salts especially phosphates of calcium, chloride of sodium, salts of potassium, magnesium, iron, etc. and (5) water. The average composition of human, cow's, buffaloe's and goat's milk is given on p. 45.

Human milk contains more sugar than cow's milk but less proteins and salts—hence the general rule of diluting cow's milk and adding a little sugar and cream when preparing milk for infants, if it becomes necessary to feed them on cow's milk.

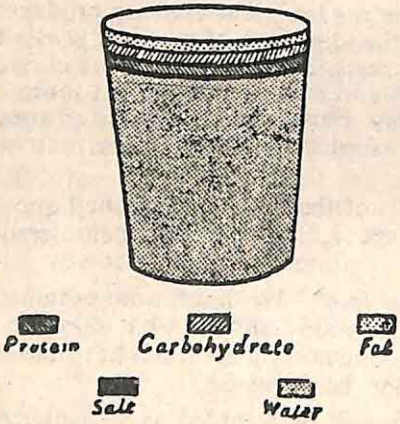

Fig 12.—Composition of a glass of milk

These milks are commonly used in India.

	Water	Proteins	Fat	Sugar	Salts
Human milk	87.4	2.3	3.8	6.2	0.3
Cow's milk	87.2	3.5	3.7	4.9	0.7
Buffaloe's milk	82.2	4.4	7.7	4.8	0.9
Goat's milk	86.9	3.5	4.1	4.6	0.9

When milk is lett undisturbed for a few hours, the fat rises to the top, constituting what is known as cream. Good milk should yield 8 to 11 per cent of its volume of cream. This can be tested by a cream measurer, which is simply a narrow glass vessel marked into 100 divisions on its side, Fill this with milk and let it stand for 12 hours. The cream will rise to the top, and if the milk is good, should occupy 8 to 11 divisions at the top. If the cream be removed from the surface of the milk, what is left is called skimmed milk, and consists of water in which are dissolved the casein, milk-sugar (lactose), and salts. On the addition of any weak acid, say a little acetic or vinegar to skimmed milk, the casein is precipitated as solid curds and a liquid called whey is separated. This whey contains the soluble salts and lactose.

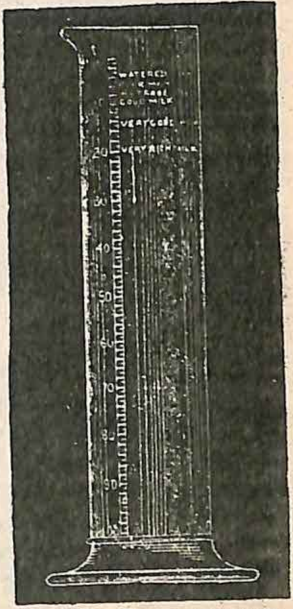

Fig. 13.—Cream measurer

The chief *adulterations* of milk are the addition of water and the removal of cream. Added water can sometimes be detected by taking the specific gravity of the milk by means of a lactometer. This instrument consists of a glass stem with a bulb at one end weighted with mercury to keep it erect; on the stem is a graduated scale. Milk is put in a narrow jar, and the mark on a scale to which the instrument sinks in the milk is read off as specific gravity. If the density of water be taken as 1,000, that of good milk may vary from 1,027 to 1,034. Some lactometers (Fig. 14) are so marked as to show how many parts of water and of milk are present in a given sample. But too much reliance cannot be placed on such instruments. We must remember that the specific gravity is the result of three things. (i) The amount of fat in the milk, which lowers the gravity—that is, makes it nearer to that of water, because fat is lighter than water; for this reason pure milk which happens to be rich in fat often shows a lower gravity than one which has been skimmed or deprived of its cream, (ii) the quantity of water in the milk which lowers the gravity, (iii) the amount of milk-sugar and salts, which increase the gravity by adding to its weight as compared with water. If we are using a lactometer, and the milkman is clever, he would remove part of the cream, which would naturally raise the specific gravity, and then by adding water bring the specific gravity down to the normal. The use of a lactometer alone would not detect this fraud. If the lactometer shows a density several degrees less than 1,030 and at the same time less than 8 per cent cream rises in twelve hours in the cream measurer water has certainly been added to the milk. The ordinary *halwai* bases his estimate of the quality of milk on the amount of *khoya* (total solids plus a certain quantity of water) he can get out of it. If he does not obtain 4 *chattaks* per seer of milk he will most certainly come down on the *guala* and demand better value for his money, though the *halwai* himself in his turn may cheat his customers as much as he likes. Starch flour, in the form of *singhare ka atta*, is sometimes sprinkled over milk which is being boiled, so as to form a thick layer

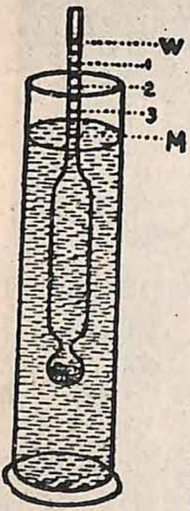

Fig. 14
A Lactometer

of so-called *malai* over it. This could of course be readily detected by the iodine test for starch.

The prevention of Food Adulteration Act is hardly ever put into operation with the result that large scale adulteration of food stuffs goes on. Except in a few large towns there is very great difficulty in obtaining pure milk. For these reasons, the writers would strongly recommend all people who can afford to do so, to keep their own cows. But this cannot be done in congested cities, where, however, the Government is now trying to supply milk by opening big dairies. The milk is pasteurised, refrigerated and supplied in sterilized bottles.

Sanitary control of milk supply: Milk being an important article of diet, it is essential that every precaution be taken to ensure its purity and freedom from dirt. To achieve this there should be sanitary control of cows, cowsheds, milk pails and milkers. Cows should be housed in clean cowsheds, cows should be well groomed, udders washed before milking, all milk pails should be washed with clean water after use, then sterilised, and milkers should wash their hands before milking. So long as these precautions are not taken, milk should not be taken raw but boiled or pasteurised, in pasteurisation milk is heated to just below boiling point (150°F), keeping it at this temperature for 30 minutes and then rapidly cooling it by refrigeration to a temperature of 55°F. In boiling vitamin C is destroyed, milk protein is coagulated and milk becomes thicker, brownish in colour and taste is changed. .These changes do not take place in pasteurisation and pasteurised milk keeps longer.

Dahi or milk-curd (prepared in the way so familiar to us all) is a very good food and contains everything there is in milk. It is, therefore, a good milk substitute.

Butter.—This is almost a pure fat. It is obtained by churning pure milk or cream, or in Indian homes by churning *dahi* so that particles of fat run together and are separated.

When butter is separated from *dahi*, buttermilk (*chhachh* or *lassi*) is left, which is a very nutritious substance, containing practically everything in the milk except the fat. It is a very good thing that it is so largely used in country places as an article of food along with some starchy food (*roti* or *chapattis*) and the practice of distributing *lassi* among one's neighbours is not without significance. It forms a valuable diet for invalids who are unable to digest fat, and for children suffering from wasting diseases.

Butter is often fraudulently mixed with other animal or vegetable fats, which, though nutritious substances, are less easily digestible than butter and lack vitamins.

Ghee is butter which has been strongly heated, so as to destroy all traces of water and nitrogenous substances found in butter, in order that it may keep better. Ghee is frequently adulterated by adding water and working it up with it, also by adding vegetable oils (such as rapeseed oil, coconut oil etc.) or fat from beef or mutton. In England, all artificial butters (i.e. those in which a certain amount of genuine butter is mixed with animal or vegetable fats) are required by law to be called and sold as *margarine*, in the United States of America they are termed *Oleo-margarine*. During the last few years vegetable ghee is largely being manufactured in this *country* and has replaced genuine *ghee* in poor and middle class families. It is known as *Vanaspati* and is sold as such, and being so much cheaper is also used on an extensive scale to adulterate genuine ghee. It is yet to be seen if the vegetable fats have the same food value as ghee, but vitamins are certainly wanting.

Cheese.—Cheese is made by warming milk and then adding a little acid, or else a piece of rennet, by which casein is coagulated or rendered insoluble. This along with the fat is then separated from the liquid part of whey by straining, and the mixture of curd and fat put into moulds and dried by pressure. The varieties of cheese chiefly depend upon the proportions of fat contained in them. The poorest kinds, namely, those made from skimmed milk, are very hard and difficult of digestion. Those made from unskimmed milk are good and more digestible. Cheese is kept for longer or shorter periods, to undergo 'ripening' or decomposition for the purpose of yielding a particular flavour. Roasting the cheese renders it very indigestible. In Indian homes, cheese is generally prepared from fresh curd or *dahi* which is suspended in a muslin bag and allowed to strain off; it is eaten without being allowed to ripen.

As an article of diet cheese is very useful, being particularly rich in both protein and fat, and would be a good substitute for meat, were it not for the fact that some people occasionally find it indigestible.

Eggs.—As the chick is developed from the egg, it is obvious that eggs must contain everything necessary for the construction of the body. A glance at Fig. 15 will show that, apart from water, the white of an egg is almost pure albumen, and the yolk contains a large percentage of fat and a considerable quantity of albumen. The percentage of salts (the shell being excepted) is very small, and there are no starches or sugars. The want of salts is made up for, while the chick is developing inside the egg, by the solution of the shell, and the insufficiency of heat-producing substances is counter-balanced by the heat imparted in the process of incubation. Eggs form a very valuable article of diet, being rich in protein and fat. The yolk is a very nourishing food, the large proportion of fats which it contains being in a digestible form. The white is a very digestible

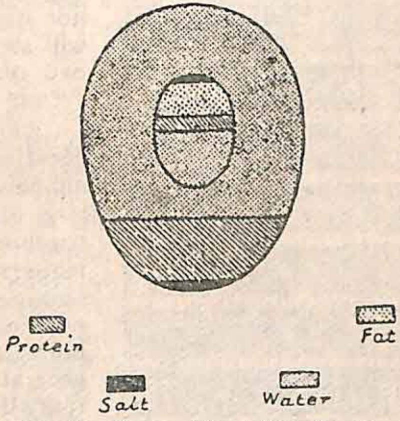

Fig. 15—Composition of hen's egg.

form of albumen when raw or slightly cooked; if it becomes hard (as in hard-boiled eggs) it is attacked by the gastric juice with much greater difficulty and is, therefore, more indigestible. For this reason raw eggs are more easily digestible than boiled ones. The white and yolk of a raw egg may be beaten up in a cup with a spoon, and some milk added. Taken in this form, they will be found particularly useful by invalids.

To determine if eggs are fresh, dissolve 1/2 *chattak* of common salt in 5 *chattaks* of water, and put the eggs one by one in this solution. A good egg will sink, one not quite so fresh will swim, while a bad one will float even in pure water.

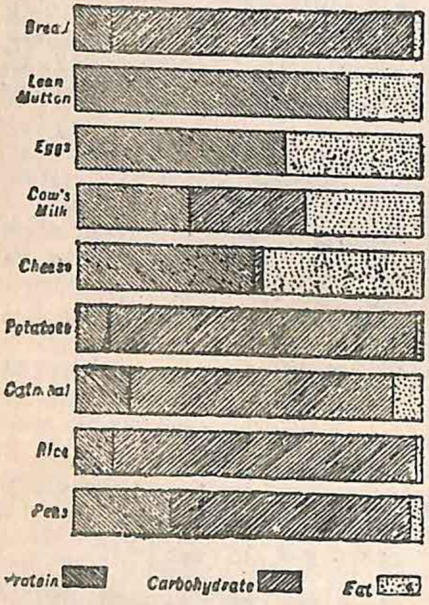

Fig. 16.—Diagram to show the relative proportions of Proteins, Carbohydrates, and Fats in common foods. The water and mineral salts are not represented.

(*From Cathcart's Book of Physiology and Hygiene,—Macmillan & Co,*)

Animal Foods.—Meat, or the flesh of animals, contains a large amount of nitrogenous and fatty matters and many important salts, but practically no carbohydrates. As a general rule, animal foods like meat, fish or poultry are more easily digested than protein and fatty foods derived from the vegetable world. Animal foods are commonly divided into red meats and white meats; of red meats mutton, beef and pork are the chief examples; the white meats include chicken, geese and rabbits. Of these beef and pork are interdicted on very good grounds by the religions of Hindus and Muhammedans respectively, and in our opinion both had better been avoided by all. White meats contain a smaller percentage of proteins than the red ones, and are, therefore, less nutritious. They are, however, as a rule more digestible, and so are well suited for invalids. Of the red meats, mutton is the most digestible and best suited for invalids. Goat's meat is much used in this country. It is somewhat darker and tougher than mutton (sheep's meat).

Good fresh meat is firm and elastic, with a bright uniform colour. If it is too dark or too light in colour, or on cutting, it is softer at some places than at others, it is bad. The fat should be firm, with a clear white appearance. The odour should be faint. There must be no greenish colour or bad smell, for these are sure signs that decomposition has set in.

In cooking meat the object should be to keep in it as much of the nutritious matter as possible. The joint should be plunged into boiling water and boiling maintained for five minutes. This coagulates the albumen on the outside, and forms a coat through which meat juices cannot escape. For the rest of the time the water should not be allowed to boil at all, but kept at a more moderate heat. If the water is kept boiling throughout, the meat becomes hard and indigestible. If, on the other hand, it is desired to make a nutritious broth or soup, the meat should be cut up into small pieces and placed in cold water. After it has soaked for a while, heat should be applied slowly. If a broth is to be made, no actual boiling should be allowed; by this means the albumen of the meat is not solidified but dissolves in water together with a part of the meat juices. In making soup the same procedure is adopted, with this difference, however, that at the end boiling is allowed for some time whereby practically all the nourishment from the meat is extracted and the meat is left as a hard, tasteless, fibrous mass. Nowadays meat and tough vegetables are cooked in Pressure Cookers with much saving of time and fuel.

The flesh of fish contains more water and less nitrogenous matter than meat, and is consequently, more easily digestible. It contains a larger percentage of phosphates than meat, which has given rise to the popular supposition that fish is more particularly a 'brain food'. In all probability it possesses no superiority over meat in this respect.

Vegetable Foods.—The vegetable foods may be divided into six great classes, namely, the cereals or grains, the pulses or various kinds of *dals*, the roots and tubers, ordinary green vegetables, fruits, and the edible fungi.. They all contain proteins, carbohydrates and fats in varying proportions, but carbohydartes (starches and sugars) are much in excess of the other two. The only classes of vegetable foods that contain any important amount of proteins are pulses (peas, beans, and dals) which contain over 20 per cent of proteins, and some of the cereals (wheat, maize, barley, oats, etc.) which contain more than 10 per cent. The proteins present are legumin, glutenin, or albumen. The carbohydrates are in the form of starches, cellulose and sugars, and fats in the form of various vegetable oils.

The cereals include wheat, maize, barley, oats and rice. The grains of one or the other of these form the staple food of the people in different parts of India. These grains contain a large quantity of starch, some nitrogenous substances, one of which called 'glutenin' is peculiar to them, and mineral salts especially phosphate of lime. The grains are ground, and so the various flours or meals are produced, the outer coating being generally sifted off and removed as bran. It is important, however, to remember that most of the nitrogenous matter (glutenin) is contained just within the outer coat of the grain and is lost in the case of very finely ground flour.

Wheat contains, besides a large quantity of starch, a fair amount of glutenin. Too much of the outside shell should not, however, be removed, as much of the nitrogenous matter would be lost by so doing. Wheat flour is sold as *atta*, *maida*, *soojee*. Of these *atta* is mostly used for making bread (*double roti*) and *chapattis* or *phulkas*. The flour is kneaded into a pasty dough, and it is the glutenin (a sticky substance, hence the name) which enables this to be done. *Chapattis* are made from this dough in the way familiar to every one. In the manufacture of bread, the dough is rendered light by causing it to be permeated with bubbles of gas, produced either by fermentation, set up by the presence of yeast, or by baking powders which consist of mixtures of carbonate of soda and tartaric or citric acid, which give off carbonic acid gas when mixed with the wet dough. Bread is, therefore, easier to digest than ordinary *chapattis*. New bread is, however, not easily digested, as it forms a pasty mass in the mouth and the starch in it is not properly attacked by saliva. It is for this reason that a loaf of bread is cut up into slices which are toasted. These 'toasts' are crisp, are readily broken into fragments by the teeth, and are easily digested as those fragments get throughly mixed up with saliva. Brown bread is prepared from the whole flour containing the bran as well as the inner part of the grain. It is less digestible than the white bread, since the bran, although containing a larger proportion of nutritious substance, also contains a good deal of indigestible

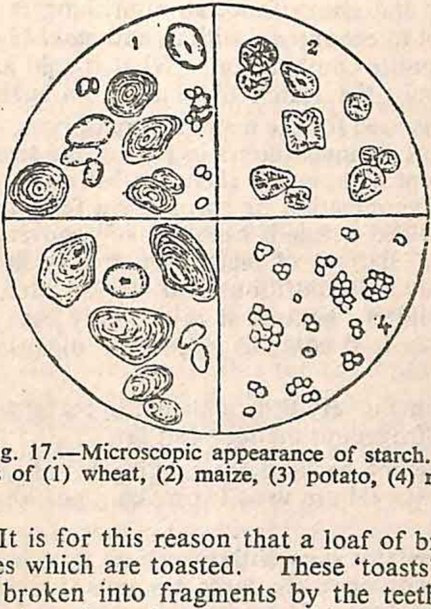

Fig. 17.—Microscopic appearance of starch.
Grains of (1) wheat, (2) maize, (3) potato, (4) rice.

woody fibre. It acts, however, as a mechanical stimulant to the coats of the stomach and intestines and so proves useful for persons suffering from habitual constipation. For the same reason, *dalia*, (crushed whole wheat), provided it is throughly well cooked, is a nutritious article of diet.

Chapattis should not be made too thick and must be carefully cooked. They ought to be light and swollen in the middle with air. *Chapattis* made of wheat-flour with groundup *dal* (*missi roti*) are more nourishing since they contain more nitrogenous and fatty substances.

Maize contains besides starch a very large proportion of fatty and nitrogenous matters, and forms a good, nourishing and cheap food, so nourishing in fact that it is usual not to eat any *dal* with it, and *maki ki roti* and *sag* are a favourite combination. What is sold as corn-flour contains only the starch obtained from maize.

Barley is used for the manufacture of beer. It is allowed to sprout on moist flours in rooms, the temperature of which is kept high, and is then called malt. During the process of germination or sprouting a ferment called distaste is formed which is capable of converting starch into sugar. Extract of malt has a treacly fluid obtained from malt. It is nutritious and is a useful food for delicate children, because it is not only easily digestible, but the distaste it contains helps the digestion of other starchy foods.

Oats contain very little glutenin, but a large proportion of other nitrogenous matters and fat.

Oats cannot be used for making bread, but crushed oats and oatmeal are used for making porridge and other dishes.

Rice contains very little proteins, fats and salts. Its value depends upon the large amount of easily digestible starch it contains. It is usually taken along with other foods such as *dal*, fish, meat, or milk. Cooked with *dal* as *Khichri*, or with milk as *khir* they form very useful and nourishing diets. Rice protein more closely resembles an animal protein in its amonio acid make-up than does any other cereal protein. So rice contains better protein than wheat, and those vegetarians whose staple food is wheat, should occasionally use rice also.

Parboiled, milled or hand-husked rice are the common varieties sold in the market. In the parboiled, the paddy is soaked and then steamed to burst open the husks, and finally dried in the sun and husks removed. In the milled rice the husks are removed by machinery. It is also called polished rice. In the hand-husked or home-made rice, the paddy is soaked in cold water for one or two days and then dried and husks removed by pounding. Of all these varieties, hand-husked rice is the most nutritious as vitamins and minerals are retained, which are lost in polishing in the milled variety. The parboiled comes in between the two as regards nutrition and appearance.

If rice is boiled in water, much of the nitrogenous matter and salts become dissolved in the water. So rice-water (or *pichh*) should not be thrown away as it contains these nourishing substances. Rice should not be boiled but steamed.

Pulses.—These include peas, beans, and various *dals*. The varieties of *dal* are *mash*, *mung*, *chana*, *massur*, and *arhar*. *Mung ki dal* is specially good for invalids and children. Lentils (*mash ki dal*) are the most nutritious of the pulses containing much nitrogenous matter and a good deal of iron. All pulses are remarkable for the large amount of protein which they contain in the form of legumin. They contain quite as much nitrogenous matter as fish or meat, though vegetable protein needs to be supplemented by animal protein. They need to be well cooked, otherwise they are extremely difficult to digest. Combined with a little *ghee* and eaten with some kind of cereal food, they are very important articles of diet. The common Punjabi saying '*Dal roti khain nak di sede jain*' (eat *dal* and *roti* and go straight as thy nose indicates) inculcates a principle of great physiological and ethical value.

The great nutritive value of *dals* is fully recognized, and *besan* (*dal* ground up into a meal) and *pithi* (mashed pulse) are the basis of a large variety of dishes, such as *bhallas* and *pakoris* (*dal* cakes fried in oil and soaked in milk-curds), *kachowris* (cake of. pulse and wheat-flour fried in ghee), *gulgullas* (small balls of pulse and flour fried in oil). It must be remembered, that as a rule all things prepared by frying in ghee or oil are more difficult to digest, and such things should be taken only occasionaly to give variety, and not as articles of daily diet.

Various *roots* and *stems* are chiefly used for their starch and in some cases for their salts as well. Carrots, sweet potatoes (*shakarkandi*), radishes and turnips, potatoes, *kachalus* and artichokes may be mentioned as examples. Potatoes contain a large quantity of starch and a small quantity of proteins, which are very valuable, as they are similar in their make-up to the animal proteins. Carrots and sweet potatoes contain cane-sugar. Arrowroot is a pure starch obtained from the tuber of a plant. Sago is a pure starch obtained from the pith of the stem of a certain palm. Both these are easily digestible and are much used as food for invailds. Sugar obtained from the sugarcane and the beet-root is an important carbohydrate food, but bazaar sweetmeats should only be taken in moderation by healthy people and not at all by sick people or those with a weak digestion. Money spent on them can be more usefully spent on other good and nourishing articles of diet.

Green Vegetables such as cabbage, cauliflower, *sag*, onions, vegetable marrow, *karelas*, *toris*, *baingans*, etc., are not very nutritious, but contain many necessary salts, and give the necessary variety and relish to the food. They contain little or no starch, but an indigestible substance called cellulose, which is useful in stimulating the movements of the intestines and thus preventing constipation.

Fruits, such as apples, pears, oranges, mangoes, grapes, are particularly rich in salts of potash and vegetable acids; Some fruits such as grapes, mangoes and melons contain only sugar, but no starch. Most fruits contain a large amount of water, and both on account of it and the contained salts act as laxatives. When eaten, fruit should not be overripe, but as fresh as possible and quite free from any signs of decomposition. Some fruits, like dates, figs and apricots, can be dried.

The *edible fungi*, as mushrooms, contain over ninety per cent of water and a little nitrogenous matter. They are usually very indigestible and of practically no value as food

Preservation of food.—All foods are liable to go bad if exposed to changing atmospheric conditions. To preserve food, therefore, various methods are employed, such as adding salt or oil as in *achars* or salted fish, adding sugar in the preparation of jams, drying as in dried dates, figs and apricots or dried vegetables, or by the addition of chemical substances like lactic acid or vinegar. But in all these cases properties of the food are affected as regards taste, smell, vitamins and mineral contents. Scientists have found that if meat, milk and other perishable products such as fruits and vegetables are stored in cold they last much longer than at ordinary temperatures. They have now succeeded in developing a machine which would produce cold. This machine is called a *Refrigerating* machine and the science of producing artificial cold is called refrigeration. For household use Refrigerators or Frigidaires are being manufactured, while for storing large quantities of perishable fruits and vegetables *cold storage* godowns are being built all over the country. These not only save thousands of rupees by preserving perishable articles of food, but supply to the people out of season fruits and vegetables almost fresh in taste, smell, vitamin and mineral contents and food value.

Questions

1. What is food and why do we eat it?
2. Compare and contrast the human body to a steam engine.
3. What are 'proximal principles' of diet ? Discuss their functions.
4. Define 'Vitamins'. Name the important vitamins and give their functions.
5. Discuss the relative importance of the following articles of diet: milk, eggs, wheat, rice, meat, fish, pulses, vegetables and fruits.

6. What is 'perfect food'?
7. Name the diseases caused by overfeeding and underfeeding.
8. What are the chief adulterations of milk and how would you detect them?
9. What food will you give to an infant 6 months old?
10. Describe the varying methods of preservation of foods.

CHAPTER VI

BEVERAGES

WATER is the natural beverage of mankind. It is absolutely necessary to drink a certain quantity of water, in accordance with the needs of the body. Water is also taken in the form of sherbets and aerated waters. Milk is another excellent beverage and its value as a food has already been discussed. Other common beverages used are tea, coffee, cocoa, and alcohol in some form. These are discussed in greater detail in the following paragraphs.

Aerated Waters.—These have come into general use of late years. They are prepared by forcing carbonic acid gas into ordinary water, and adding to it some sugar, saline or a flavouring agent. Much of what is known and largely sold as 'soda water' really contains no soda at all, but is merely ordinary water highly charged with carbon dioxide. These drinks are pleasant and refreshing to take, but drinking several bottles at a time or adding much ice to them are injurious practices. There is a danger in taking them, if originally impure water has been used in their manufacture. Coloured waters, of inferior quality, are liable to contain poisonous colouring matter. The same glass should not be used by several persons, without thoroughly washing it.

Lassi, Sherbet, etc.—Milk diluted with water and buttermilk (*chhachh* or *lassi*) are refreshing drinks and have a definite food value also. Sherbets of various kinds are also in general use. The juice of fresh lemons squeezed into *sherbet* makes a very refreshing and useful drink, as it is rich in Vitamin C.

Non-Alcoholic Stimulant Beverages.—These are tea, coffee and cocoa. Infusions from these plants or from other plants possessing similar properties are used all over the world. In each case there is an active stimulating agent, known as *theine* in the case of tea, and *caffeine* in the case of coffee. The action of these substances taken in moderation is to quicken and strengthen respiration and the heart's action. They also stimulate the nervous system, and lessen fatigue and the desire for sleep. They are valuable specially in reducing the immediate evil effects of overwork. For this purpose they may safely be used, in moderation, but never under the delusion that they give strength, or as substitutes for milk. Tea, coffee and cocoa also contain characteristic aromatic oils, to which each owes its distinctive smell. Tea also contains about fourteen per cent of an astringent substance called *tannin*, to which its injurious effects are largely due, when tea is badly prepared or taken in excess. Coffee also contains a small amount of tannin, but cocoa practically none.

Tea consists of dried leaves of the tea-plant which grows in India, Ceylon, China and Japan. In selecting a tea, pour a little boiling water over the leaves and examine them to see whether the leaf was a whole leaf and not a large leaf cut into small pieces. The larger the leaves, the weaker will be the infusion, and the less its value. When uncurled in this way, the tea leaf is seen to have a characteristic ovate shape and a serrated edge. The chief adulteration of tea is the admixture of old and exhausted tea leaves, that is, those which have been used and dried again.

To make good tea, water that is actually boiling should be poured over the leaves. Tea should not be allowed to stand for more than five minutes, and at the end of this time it should be poured off the leaves into the cups or into another pot. If tea is infused for a longer time than five minutes, it is liable to contain excessive quantities of tannin and is very injurious. Prepared tea as sold in the bazaars at many so-called tea shops has generally been made some time before, and is being constantly re-warmed. It is, therefore, very injurious to health.

Tea is in no way a food, but if used in moderation serves a useful purpose. As stated already, it acts as a restorative to the nervous and muscular systems, and stimulates the heart and respiration. Its great value lies in the fact that the stimulation produced is followed by no after-depression. Tea has been found to be of great benefit to soliders on active service, and in all cases where continuous exertion is required it is enormously superior to alcohol as a stimulant. If badly prepared, or taken in great excess, it causes indigestion, loss of appetite, with constipation, and in the long run may lead to nervousness and palpitation of the heart. In some persons, constipation and sleeplessness are caused even when small quantities are consumed. Tea should not be drunk too hot, so that it may not injure the lining membrane of the stomach. It should not be drunk by itself, but when other food is being taken; it is not advisable, however, to take it with meat or even eggs as tannin may combine with albumen and the tannate of albumen is indigestible. When taken with milk and sugar a cup of tea is both nourishing and stimulating.

Coffee is the berry of a plant growing in Brazil, Central Africa, Arabia and other countries. The seeds are roasted to a dark brown colour, and are then ground to a powder in a mill. The action of coffee upon the body is very similar to that of tea. The infusion is prepared like tea, but may be allowed to stand for ten or fifteen minutes.

Cocoa is derived from the roasted seeds of a tree growing in the West Indies, the west coast of Africa and South America. Cocoa contains a substance very similar in properties and composition to theine, but it contains also a considerable proportion of nitrogenous and fatty matters, and, therefore, forms a nutritious beverage, especially when prepared, as it usually is, with milk. It is a weaker stimulant than tea or coffee, and is less liable to produce wakefulness. In making cocoa, we do not prepare an infusion as in tea or coffee but we drink the whole. It should be thoroughly well boiled in water or better still in milk. As a drink it is much better than tea.

Alcoholic beverages.—Under this head are included all the various liquors which contain the products of fermentation, the most important product being alcohol. If a substance called yeast (which consists of living, actively growing and multiplying organisms) is added to any sugary solution the sugar is changed by the yeast into carbon dioxide and alcohol, and at the same time various ethers and acids are formed. This process is known in Chemistry as fermentation. In the manufacture of alcoholic liquors, alcohol is formed from fermentation of natural sugars such as cane sugar (*gur* or treacle), in the manufacture of rum, and grape sugar found in grapes, in the manufacture of wines, or by first converting starch into sugar. The conversion of starch into sugar is brought about by a natural process, as in malting barley for the manufacture of beer, or by artificial means as in making potato spirit.

The following list gives roughly the amount of alcohol contained in some of the commonest drinks:

Brandy	..	55 per cent	Sherry	...	23 per cent
Whisky	...	54 ,, ,,	Port	...	22 ,, ,,
Rum	...	53 ,, ,,	Beer	...	3 ,, ,,

Effects of alcohol.—In small doses, alcohol stimulates the nervous system, reddens the lining membrane of the stomach, thus increasing the secretion of the gastric juice, and promoting the appetite. It passes directly through the lining membrane of the stomach and reaches the blood. The heart is reflexly stimulated and caused to beat more quickly and more forcibly for a time. The smaller blood-vessels become dilated, which effect gave rise to the old notion that alcohol warms the body and, therefore, should be taken when the body is about to be exposed to severe cold. This a most dangerous fallacy. As a matter of fact, alcohol lowers the temperature of the body by dilating the blood-vessels just beneath the skin, and so increasing the loss of heat from the skin. The skin feels warmer, but the body is actually becoming colder. The use of alcohol, moreover, lessens the power of resistance to cold and to diseases especially those due to germs. In the case of the regular tippler, the vessels beneath the skin, especially about the nose become permanently dilated, and it would be quite wrong to regard a red nose as a sign of added strength. Even in small doses, the habitual use of alcohol is injurious, as any stimulation produced by alcohol is always followed by a period of depression, and the acuteness of all the senses is diminished by such use.

In larger doses, alcohol depresses and paralyses the nervous system, and in still larger quantities it acts as a dangerous narcotic poison like opium. These effects are well seen in the various stages of drunkenness—the excitement (during which the person talks incoherently, walks about with a staggering gait and does actions of which he would feel ashamed if sober), the sleep, the 'dead drunk' stage and even death. If taken repeatedly in large quantities as in drinking spirits habitually, the various organs of the body rapidly become diseased. It produces diseases of the stomach, liver, heart, kidneys, brain and nerves—even leading to delirium tremens, or insanity. Indigestion is caused by an alteration of the mucous membrane of the stomach, which prevents it from performing its function properly and consequently brings about a deficient nutrition of the blood, since if food is not properly digested it cannot be absorbed. Then an alteration takes place in the liver, to which organ the blood from the stomach and intestines containing alcohol goes first of all. The kidneys, the important organs of excretion, also become diseased, and so kidney disease is far more prevalent among those who drink alcoholic liquors than amongst those who do not.

It has been proved quite conclusively that men who drink spirits are capable of doing much less work than those who do not, and the same persons are able to do much less work when spirits form part of their food than when they do not. Soldiers on the march, in all sorts of climate, can endure more fatigue, are healthier, and fight better without alcoholic stimulants than with them.

On physiological grounds alone the habitual use of all forms of alcoholic drinks must be unhesitatingly condemned. For all practical purposes, alcohol has no value whatever as food. A person can do quite as hard, if not harder, work without alcohol than with it. The money spent on such drinks is, therefore, money wasted—money which should be spent in a better manner by giving people healthy and clean homes and good food and clothing. Poverty, misery, crime and insanity are some of the fruits of the baneful habit of indulging in alcoholic drinks. In small and strictly restricted doses, the habitual use of alcohol may not produce any *obvious* ill effects, but there is no guarantee that a person will keep to such small doses, as the use of alcoholic drinks in moderation certainly produces a craving for their use in larger and stronger doses. *Total abstinence from all intoxicating liquors is therefore the wisest and the safest plan.*

Alcohol in certain conditions of disease is one of the most valuable medicines, and while we have counselled our young readers to be lifelong total abstainers, we have no desire to produce any prejudice against its use when prescribed by a doctor. Many medical men of other countries and of our own country have expressed the opinion that alcohol like arsenic should be regarded as a drug and only employed when prescribed by a doctor, for a period of limited duration, i.e. only while the symptoms last for which the prescription is originally given.

Tobacco—Tobacco-smoking should never be indulged in by any one under twenty-one years of age. In the Panjab and certain other parts of India, smoking by children under sixteen years of age has been made punishable by law, and it is the duty of all teachers and others interested in the welfare of young children to check the evil of juvenile smoking.

Smoking of tobacco is becoming alarmingly common among all classes of people. The effects of excessive smoking are very harmful to the system. Smoking raises blood pressure, quickens the heart and respiration, and may lead to dyspepsia, irritation of the throat, pain and irregularity of the heart, impaired eyesight, tremors of the hands and thickening of the bloodvessels.

Other Intoxicating drugs.—Various other drugs like *opium*, *ganja*, *charas*, *bhang*, etc, are used by the people for intoxicating purposes. All these are very injurious to health. Opium is a narcotic poison. Ignorant mothers sometimes give a little of it to infants so that they may sleep for longer hours and not disturb them in their work. This is a most wicked practice and sometimes proves fatal. Opium is a very valuable medicine but should only be used if and when prescribed by a doctor.

Questions

1. Name the common beverages used in India, their uses and abuses.
2. Discuss the uses and abuses of (*a*) alcohol, (*b*) tobacco, (*c*) tea.
3. Discuss the relative value, as a beverage, of milk, *lassi*, cocoa, coffee, tea, sherbet, fresh lemon juice and alcohol.
4. What are the dangers of drinking cheap aerated waters?
5. What are the dangers of drinking cold drinks like sherbets and aerated waters at Railway platforms?

CHAPTER VII

THE PRINCIPLES OF DIET

General Principles.—In a previous chapter we have discussed the nature, uses and nutritive value of various food-stuffs individually. It is necessary now to consider how they should be taken collectively in order to maintain life. No one group of food-substances is alone sufficient to sustain life for any length of time and a mixed diet is necessary. A diet consisting of carbohydrates, water and salt would support life for a short time only. A diet of proteins, salts and water would support life for a much longer period, but even this would not do. Protein and some non-nitrogenous matter should be taken together in a diet, in certain necessary proportions, and better still the three great classes of foods, viz., proteins, fats and carbohydrates, must all be represented, in addition to water, salts and vitamins. The necessity of doing so is shown by individual inclination, experience of different nationalities and actual scientific experiments. If a man attempted to live on meat alone, he would get too much proteins and fats and no carbohydrates; if on bread alone, too much carbohydrates, and too little nitrogenous matter and no fat, and so on if a man lives on potatoes, rice or maize alone. As a matter of fact, however, people have by experience chosen a *mixed* diet which contains the various proximal substances in about the right proportion. Thus we eat *dal roti* or rice and *dal*, or rice and fish, or meat and potatoes, *Khichri* (rice and dal cooked together), *khir* (milk and rice), and *dahi khichri* (*khichri* taken with milk curds), and other examples of combinations of foods.

The energy value of food is commonly expressed as the number of calories yielded by a gramme of it. A food calorie is the amount of heat required to raise the temperature of 1 kilogram of water through 1°C. The calorie value of food varies with its nature. Thus 1 gram of protein yields 4.1 calories, 1 gram of fat 9.3 and 1 gram of carbohydrate 4.1 calories. It has been estimated that 3,400 calories in the food as purchased, is a safe figure for the daily requirement of a man of average stature, leading a healthy life, with moderate muscular exertion, and that this total may be rightly obtained by taking the following:

First-class protein 50 grams per day yielding	..	205 calories
Second-class protein 50 grams per day yielding	..	205 ,,
Fat 100 grams per day yielding	..	930 ,,
Carbohydrate 500 grams per day yielding	..	2,050 ,,
Total	..	3,390 calories

In the above table the weights of dry food substances are given, but in practice, these would be found combined with quite their own weight of water.

The chief influences which affect the amount of food and drink are sex, age, work and climate. As regards *sex*, women are said to need one-tenth less food than man, but it is probably due to their work being lighter than man's work. Nursing mothers should take better and more nourishing food. In reference to *age*, during young life nitrogenous and fatty foods are particularly needful to provide for the growth of tissue; in old age, proportionate reductions are demanded. If people are doing a great amount of *work* there is a natural need of more food of all kinds, but more particularly heat-producing food: and in a state of idleness or rest (as in illness or if a person takes little exercise) less food should be consumed. For brain workers, well-cooked and easily digestible food in sufficient (but not too great) quantities is best, so that as little strain as possible is put on the digestive system. As regards *climate*, it is well known that in cold countries more fat is consumed than in hot countries, and for the same reason we take more fat in winter than in summer.

Variety in food is very desirable as it improves the appetite. Even if the same food is taken, it should not always be cooked in the same way.

When and How to Eat.—Not only should attention be given to the quantity and quality of food, but also to the methods of cooking and taking it. Meals should be taken regularly at fixed hours with a sufficient interval between two meals. It is found that an ordinary meal remains in the stomach for about four hours and is then passed on. A little more time should be given for the stomach to have some rest. It would be best, therefore, to take *three* meals a day at intervals of about five or six hours. If only two meals are to be taken, the first hearty meal should not be taken too soon, or the interval between it and the second meal would be too long. It is a mistake to leave too long an interval between meals, because there would be a tendency to overeat at the next meal, and the stomach becoming overloaded, indigestion results. In the case of Indian villagers who take their first principal meal at midday, it is a very useful thing to have some light refreshments in the shape of *roti* and *lassi* (buttermilk) in the morning.

For town dwellers, office people, and students who have to regulate their meals in accordance with their business hours, three meals, say at nine in the morning, two or three in the afternoon, and seven or eight in the evening are clearly indicated. Children should have not less than four meals a day. Eating things during the interval between two meals is very harmful and must be avoided.

The habit of going to bed or to sleep on a full stomach after a meal is particulary injurious. A hearty meal should neither immediately follow nor precede violent exertion. In each ease the stomach is rendered unfit for the vigorous discharge of its functions. Some people sleep well after a good supper, while others would be certain to be kept awake by indigestion if they retired to rest soon after a meal. Personal peculiarity has to be respected in these matters.

If you have to go out to work in the early morning, it is best to take a little food before you go out. This would strengthen the body and disgestion at a time when their powers are at their lowest. The rule also applies to students when, as in summer, their school hours are from early morning to noon.

All food should be chewed thoroughly and slowly before it is swallowed; disregard of this rule is one of the most common causes of indigestion, as the food is imperfectly masticated and bolted down the throat before the teeth and saliva have been able to do their work. The habit of reading or attempting to learn lessons while eating should be avoided, as it produces mental preoccupation, which greatly hinders digestion; it is far more useful to have pleasant talk during meals.

Principles of Cooking.—The object of cooking food is to render it more attractive, more pleasant, more digestible, and free from germs and parasites. Cooking develops agreeable flavours and taste which increase the flow of digestive juices and stimulate the appetite. The warmth imparted by hot food also helps digestion, and has a reviving effect on the system. By means of cooking, food is partially broken up, so that it is more easily masticated and acted upon by the digestive juices. Not only is it broken up, but certain changes are also brought about in the food through cooking. The most important of these is the breaking up of starch granules in cereals and vegetables, without which we should not be able to digest the starch in our food. Some of the starch is converted into dextrin. However, proteins like albumen, myosin, and glutenin are coagulated by heat, and rendered less digestible. Hence eggs, milk and meat should not be overcooked. A good cook can obtain a great variety in the preparation of food and the same material can be prepared in many ways. Another important use of cooking is that it kills germs of disease, and parasites or their eggs that may be present in the food.

Mere cooking is not enough, it is *good cooking* that is essential, for to cook food badly is often to make it less digestible than before; and even to make it unfit to eat. A good cook can utilize food to the full extent without any waste, and present it in such a pleasing and palatable form as to stimulate the appetite. Much of the pleasure of home-life is dependent upon *good* cookery. You can well imagine the disgust of a man returning home after a day's work and finding that the meal placed before him consists of *dal* that is not well softened by cooking and *roti* that is overburnt. It should, therefore, be the ambition of every housewife to be a good cook. Even if the mistress of the home is not called upon to cook herself, she should have the necessary knowledge and skill to be able to supervise or direct. We shall not attempt to give a full account of cooking in this book but only make a few remarks as regards the various processes used.

Boiling has for its object either the extraction from the food of its nutritive matters, or their retention in it, and we have already in a previous chapter said something about the use of this method in cooking meat or preparing broth or soup from it. The best temperature for cooking is one of about 16° F., it being rarely necessary to allow the water in which any article is being cooked to actually boil. That is why most things are cooked on a slow fire. Rice is cooked slowly till the grains swell up and are sufficiently soft, and then the process is completed by steaming, so that each grain becomes dry and separate from the others. Potatoes should be placed in boiling water from the first. They should be cooked with their skins on, because boiling in the ordinary way removes the greater part of the salts that the potatoes contain.

Roasting is conducted on the same general principles as rapid boiling, namely, the retention of the nutritive juice of meat by the formation of a coagulated layer of albumen on the surface. The joint should be first exposed to a great heat for a short time to coagulate the outside, then it should be placed a little further from the fire and roasted more gently. To prevent the meat from scorching and the surface from becoming hard, melted fat is poured over the meat with a spoon every few minutes. The thin layer of fat also helps to keep in more of the nutritious substances. Roasted meat is much more tasty than boiled meat but does not digest so easily.

Boiling or *grilling* is done by placing the meat on a grid iron over a clear, hot fire. A grid iron is made of several parallel iron bars with spaces between. It is simply a form of roasting. *Kababs* are sticks of minced meat cooked in this fashion.

Baking is a very similar process to roasting, but is done in a closed oven (a small heated air chamber).

Frying is boiling a food in fat. The food cooked in this way is usually soaked with fat and is very indigestible. The method is often used for fish, but boiled fish is more digestible. Many vegetable foods are also cooked in this way. The *ghee* or oil in the frying pan (or *karahi*) should be very hot to begin with. *Puri*, *Kachowri*, *Mathi*, *Samosa*, *Bhalle*, *Pakore*, are familiar examples of articles so prepared. *Paronthas* are *chapattis* fried in ghee on an iron plate and *puras* are also similarly prepared. Though the food is rendered very tasty, articles so prepared seldom agree with persons with delicate stomachs.

Stewing is a very economical method, as all parts of the meat, even the cheapest and coarsest kinds can be used, and there is no waste in the process. The meat is well loosened, and so is easily digested. The meat should be cut into small pieces, seasoned, placed in the stew pan and just covered with cold water. It should never boil during the process. The best possible results are obtained by using a water bath for stewing. This consists simply of an inner and an outer vessel. The stew is made in the inner vessel, and the outer vessel is filled with water which is kept boiling. The water in the inner vessel remains just below the boiling point all the while.

The *Kitchen* should have all its doors and windows covered with fine wire-gauze netting or bamboo chicks to keep out the flies, as flies are one of the most dangerous sources of contamination of food. All food should be kept covered to prevent the aeeess of flies. The kitchen floor should be of cement, without any holes or depressions in which water might collect and stagnate. Such a floor should be washed well every day. *Huqas* and dirty clothes should never be allowed in the kitchen, and it should not be used as a sleeping room for the servants.

Food, goods in itself may harbour germs.—This is most frequent in the case of milk. A large number of people supplied with milk from one source have been affected with such diseases as typhoid fever, and inquiries have shown that either at the cowshed or in the milk shop germs of these diseases had got into the milk, either from the air, or more often from dirty and polluted water used either as an adulteration to the milk or for washing out the milk cans. The proper remedy for preventing these diseases, as well as tuberculosis from the milk of tuberculous cows, is to boil the milk before use.

Vegetables like cucumbers and melons often become contaminated with cholera germs, either in the field as they lie on the ground which may have been manured with human excreta or sewage water containing germs of the disease, or when they are washed, as is too often the case, with dirty canal water which people have pulluted by bathing and washing clothes. It is best to avoid such vegetables if there is an epidemic of the disease, or to take them only after carefully washing them with potassium permanganate solution.

Questions

1. What do you understand by mixed diet? Discuss its importance.
2. Discuss 'when and how to eat'.
3. What diet would you recommend to a man doing (a) hard brain work, (b) hard muscular work, and (c) leading a sedentary life?
4. Discuss the advantages and disadvantages of cooking food.
5. Describe the various methods of cooking food.
6. Discuss the advantages and disadvantages of taking (a) unboiled milk and (b) uncooked vegetables.
7. Name the diseases caused by taking unwholesome food and how can these be prevented.
8. Describe the essentials of a hygienic kitchen.

CHAPTER VIII

PERSONAL HYGIENE

THE PART of hygiene which teaches the individual how to keep himself in health by paying attention to his cleanliness, exercise, rest, sleep, etc., is known as personal hygiene. It will be easily understood that attention to the general principles of hygiene and sanitary legislation may do much to give us healthy homes to live in, pure air to breathe, pure water to drink, and good or sufficient food to eat; but even these will not suffice to keep us in health, unless attention be paid equally to matters which relate essentially to the individual. Our personal habits may, therefore, be either important aids to the promotion of health and prolongation of life, or they may be powerful predisposing causes of diseases. Thus, it is of greatest importance to our well-being that we should form habits that are beneficial, and not such as are hurtful to us. It is very important that there should be a periodic medical check-up, every six or twelve months, of our bodies, so that any disease may be detected at its very beginning and be properly treated before it has taken root.

Cleanliness.—The importance of cleanliness in all the actions of life is too evident to need much emphasis, but for the fact that it is too often neglected in acutal living. By cleanliness many diseases which are directly due to dirt will be avoided. It is important to keep the skin clean. If the skin is left unwashed, a coating of dirt, composed of sweat, oily matter,dead skin scales, particles of clothing and dust, forms on the skin and covers it like a plaster. This plaster is a good soil for germs. It also impedes the important work of the skin by blocking the openings of the skin glands, and throws extra work upon other organs, especially the kidneys. It favours pimples, boils, ringworm, the harbouring of parasites, and germs of diseases.

It is most important to develop cleanly habits while you are at school. The hair, face, hands and feet should always be clean, and the nails kept short. The coat of dirt, above referred to, being largely composed of oily matter, cannot be removed by water alone, but is easily dissolved by soap. The soap should be thoroughly removed with plenty of clean water, otherwise it may itself cake on the skin and close the pores. In cold weather the custom of rubbing oil into the skin is a good one. Cheap soaps containing much alkali are injurious to the skin, especially in cold weather, as they dry the skin too much. To keep the body clean it should be washed daily, special attention being paid to parts which perspire most, such as the armpits, etc. To wash the hands and face alone is not enough. For actual cleansing purposes, warm water is better than cold. Cold water is an excellent tonic and stimulant to the functions of the skin. After bathing, the skin should be thoroughly dried with a rough towel. This should produce a pleasant feeling of warm glow all over the body. If, however, there is a chilly feeling, or blueness of fingers, it would mean either that the cold bath has been unduly long or that it has been taken by a weak person, both of which should be avoided. Cold water should preferably be used for bathing purposes except in extreme cold weather, when warm water may be used, and the bath taken inside a closed bathroom.

The hair can be kept fairly clean by regular brushing and combing and frequent washing with soap and water. The brush should not be too hard as it increases 'scurfiness' of the head. Each person should keep a separate comb and hair brush to be used by himself only. If the same hair brush or comb is used by several people it is liable to convey lice, ringworm, etc., from one person to another.

A dirty skin and hair also prove a good soil for lice and diseases like ringworm. A louse is a small, whitish insect, which infests the hair of the head or the body. Lice bite the skin and suck blood, the biting causing great itching, which may give rise to sores and enlargement of lymphatic glands. Lice are transmitted by close contact, such as sleeping in the same bed with a lice infected person, or by the wearing of lice infested garments.

Lice can be removed by cutting the hair very short and applying DDT emulsion 2 per cent or 5 per cent DDT anti-louse powder, two or three teaspoonfuls are used, 2 to 3 drops are put in 20 to 30 different parts of scalp and—rubbed with the fingers, and the head should not be washed for ten days. Derris root, either as 2 per cent lotion or cream, is also effective, as also combing the hair with a fine comb. The lice infested garments should be well ironed or disinfected by steam.

The teeth should be regularly cleaned, otherwise 'tartar' (hard, yellowish matter) collects on them and tends to loosen them. Moreover, germs produce decomposition of food which sticks in between the teeth, causing inflammation of the gums, and the breath becomes foul. By the absorption of poisons into the system or the swallowing of germs, dyspepsia, anæmia, and other bodily disorders result. To prevent this, the mouth should be thoroughly rinsed out after each meal, and in addition, the teeth should be brushed at least twice a day, viz. in the morning and at bed-time. The Indian *datan*, if properly made into a brush, is very much cleaner and healthier to use than a tooth brush, as it obviates the use of the same brush from day to day, yet can hardly equal in benefit the use of a clean brush with a good tooth paste. While brushing, one should be careful to rub the teeth on all sides, dislodging any particles of food that may be sticking. A tooth has an outer surface, an inner surface, a cutting edge or grinding surface and lateral margins. It is important that all these are properly cleaned with brush. The spaces between the teeth may be cleaned by a silk thread passed between them. If tartar has formed it should be removed by a dentist.

The constant sucking of thumb by babies is apt to produce deformity of jaw and irregularities and protrusion of teeth. The sucking of dummy teats by babies is unhygenic. Foods requiring little chewing, and those which stick to the gums and teeth, make the teeth decay. The eating of sweets between meals should be avoided, and the meals finished with fruits. After every meal rinse your mouth thoroughly with water.

The nails should be kept fairly short so that they will not readily take up dirt. They should be kept absolutely clean.

Care of the eyes.—The eyes are extremely delicate organs, always at work during waking hours. There is danger of injury if they are overtired or used under unhealthy conditions. Thus bad lighting and too small a print are the commonest causes of short sight. Sore eyes, however, are caused by infection conveyed through dirty hands, handkerchiefs, flies, etc. The condition known as granular lids is also infectious and spreads in the same way. Whenever a person squints, or has redness or watering of the eyes, or sores on the edges of the lids, they should consult a qualified doctor, as there is danger of permanent injury by neglect. A foreign body, such as a dust particle in the eye should be removed with the corner of a clean handkerchief and the eye should not be rubbed as there is danger of scratching the cornea. After removing the foreign body a drop of castor oil or ghee should be put into the eye. In case of weak sight, proper glasses, prescribed by a competent doctor, should be worn. Much harm is often caused by obtaining spectacles from an ordinary shopkeeper or even an optician, without previously consulting an eye doctor. Spectacles should be worn as advised, and should be kept clean with a silk handkerchief.

Every part of the room should be well lighted. The light should preferably come above the left shoulder, but in no case from the front or right side. Glare should be avoided. Fine pointed objects such as nibs, pencils, etc. should not be used in infant classes. There should be no stooping or leaning over the work, and while reading the book should be placed at a distance of twelve inches from the eyes. Children under the age of six should not read printed matter.

Blindness:—Blindness or grossly diminished vision of one or both eyes is very common in this country. It not only unfits the individual for normal daily activities but puts a burden on his relatives, friends and on the State. Blindness is common at all ages. In infants the common cause is inflammation of the eyes from infection from the mother, from dirty hands of the midwife or by inflammation caused by strong antiseptics. The eyes are swollen red or bluish in colour, and the lids are glued together by pus. On opening the lids, the eyes are seen full of pus. If treated early there is complete recovery, but if neglected, it leads to blindness. It is best to consult a doctor, but if a doctor is not available, the eyes should be well washed several times a day with warm water to which Boric Acid 10 grains to an ounce are added. In children the eyes may get red and inflamed from infection or from corneal ulcers caused by foreign bodies or application of irritating remedies by unqualified persons. They complain of severe pain in the eyes, the lids are swollen and lightly closed and tears are streaming down their cheeks. They avoid light and sit in the darkest corner of the room. Corneal ulcers are very serious and a doctor must be consulted as early as possible if blindness is to be avoided. Children also suffer from dryness of the cornea, called Xerosis. It is commonly due to lack of Vitamin A which also causes night-blindness. Treatment consists in putting a drop of cod or shark liver oil into the eyes, 2 or 3 times a day and giving Vitamin A by mouth.

In adolescence the commonest cause of blindness is chronic trachoma. Due to the chronic inflammation of the conjunctiva the eye lashes are lost and the edges of lids rub on the cornea causing whiteness and opacity. In adults, high myopia not treated by suitable glasses leads to much diminution of vision and even total blindess. In old age glaucoma and cataract of one or both eyes is the commonest cause of blindness. A specialist must be consulted as the vision can be saved by timely operation.

Care of the ears.—A large number of persons get their ears diseased or even become deaf on account of neglect in care of the ears. After the daily bath, the ears should be wiped dry with a towel and if water has entered the ear passage, the head should be turned to that side, and the water allowed to flow out. Never put any twig or end of a pencil into the ear as there is danger of rupturing the drum. If there is earache, foment the ear with hot cotton wool. If there is discharge, a doctor must be consulted. In case an insect enters the ear, pour warm almond oil into it, and have the ear syringed afterwards.

Exercise.—Exercise means muscular action and involves more rapid combustion of the tissues of the body as shown by increased elimination of carbon dioxide and water, and the extra warmth one feels. Thirst and appetite are created and water and carbonaceous foods are required to supply the waste, as well as an increased amount of nitrogenous foods to replace dead tissues and organs is accelerated. Waste products are rapidly carried away for excretion whilst food material to replace waste is brought to them.

Regular exercise in the *open air* is most essential to brain workers, to purify the tissues from waste matters, as well as to simulate the action of the bowels. The aim should be to encourage general strength and activity and not to gain special expertness in feats of strength such as gymnastics, etc. Exercises like walking, running, games etc., are superior alike for physical, mental and moral training, to physical, exercises carried out to the word of command.

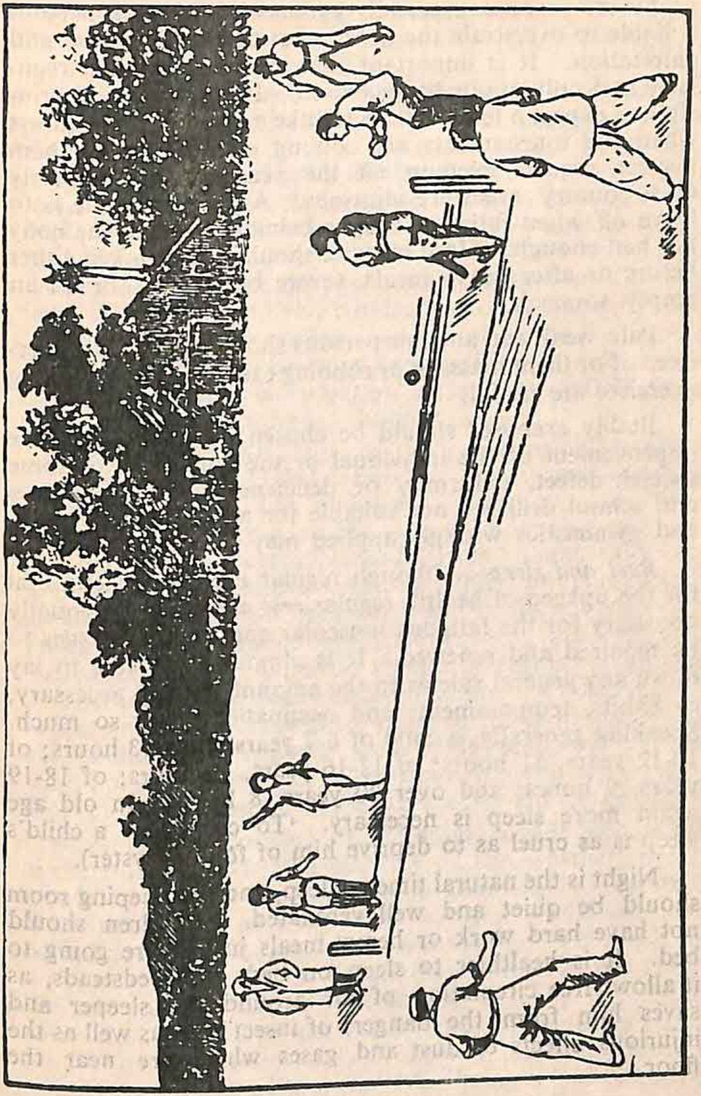

Fig. 18.—A Game of Cricket. Exercise is good for the body and the mind.
(From Macmillan & Williamson's Physics and Hygiene.—Longmans.)

Severe exercise, especially gymnastics, in weak persons is liable to overstrain the heart, causing breathlessness and palpitation. It is important that exercise be taken regularly and only gradually increased. It is not a good principle to expect a few students to take exercise for long hours when the tournaments are coming on and letting them neglect regular exercise all the year round. Similarly cross-country races are injurious. A good principle is to leave off when fatigued, fatigue being a snig that the body has had enough. Hard exercise should not be taken either before or after heavy meals, severe brain work or on an empty stomach.

Pale, weak and anæmic persons should avoid hard exercise. For them massage or rubbing exercises and breathing exercises are useful.

Bodily exercises should be chosen with a view to the improvement of the individual or the correction of some special defect, deformity or deficiency. Team exercises and school drill are not suitable for all individuals alike, and gymnastics wrongly applied may do harm.

Rest and sleep—Although regular exercise is essential for the upkeep of health, regular *rest and sleep* are equally necessary for the fatigued muscular and nervous tissues to be repaired and renewed. It is almost impossible to lay down any general rule as to the amount of sleep necessary, as habits, temperaments and occupations vary so much. Speaking generally, a child of 6-7 years needs 13 hours; of 10-12 years, 11 hours; of 13-16 years, 10 hours; of 18-19 years, 9 hours; and over 20 years, 8 hours. In old age again more sleep is necessary. 'To cut down a child's sleep is as cruel as to deprive him of food' (Lyster).

Night is the natural time to sleep, and the sleeping room should be quiet and well ventilated. Children should not have hard work or heavy meals just before going to bed. It is healthier to sleep on beds and bedsteads, as it allows free circulation of air around the sleeper and saves him from the dangers of insect bites as well as the injurious effects of dust and gases which are near the floor.

Infants and young children should not sleep in the same beds with their parents but each should sleep on a separate cot.

Care of the bowels. —Constipation is a tendency to retain fæcal residue in the bowels, with motions either too few or too small. It is a common trouble from which educated people and town dwellers suffer. The condition may be due to a variety of cases. It is usually due to (*a*) lack of exercise; (*b*) improper feeding; (*c*) neglect to answer the call of nature, (*d*) weakness of the wall of the bowels as in fatty people; (*e*) certain diseases such as anæmia, disease of the liver, stomach or intestines; (*f*) as the result of excessive smoking or use of drugs like opium; and lastly, (*g*) it occurs in acute infectious diseases and fevers. Persistent constipation leads to general ill-health, headache, furred tongue, dullness, etc.

Treatment.—The cause of the constipation should be discovered and removed. Exercise in the open should be regularly taken. The abdomen, if flabby, should be strengthened by means of massage and breathing and bending exercises. Vegetables and fruits should daily form part of the food, and sweetmeats should not be taken in abundance. Brown bread or bread made of coarse *atta*, more *ghee* in the food, vegetables like *sag*, and fresh fruits are all laxatives. A person should be regular in his daily habits and go to stools at fixed hours. A glass of cold water or hot tea taken first thing in the morning, or two teaspoonfuls of *Isapghal* or a table spoonful of liquid paraffin or almond oil at bedtime is often very useful. For more obstinate cases a doctor should be consulted.

Clothing is required to maintain animal heat, afford protection against inclemencies of the weather, protect the body from injury and also to adorn it. The clothing in winter should be warm, that is, the material should be a bad conductor of heat so as not to allow too much loss of heat by radiation. It should also be such as will readily absorb perspiration without feeling wet, e.g. fur, wool, silk. In summer, on the other hand, the clothing should be of linen or cotton so as to allow rapid evaporation of sweat, thus cooling the body. Air being a bad conductor of heat, loosely woven stuff and several layers of clothing which enclose air between them, feel warm.

The chief materials used for clothing are wool, leather silk and india-rubber, linen and cotton. Wool, leather, silk, and india-rubber are bad conductors of heat and are therefore warm, but silk can be spun so fine as to be usable in summer also. Wool has the disadvantage that it shrinks, becomes hard when washed and loses its absorbant power on account of loss of grease by the use of soap in washing. Linen and cotton are good conductors and do not prevent loss of heat from the body. Therefore these are unsuitable for winter though valuable for summer. Linen and cotton have the merit of being cheap and durable and can be washed without shrinkage and with ease. Nylon, Terrylene and Dacaron are synthetic fibres capable of being formed into filaments of great ensible tensile strength. Like cotton and wool these are woven into cloth. These do not allow evaporation of sweat and so clothes made from them are not good for summer but as they keep in the heat they are good for winter. Clothes made from these fabrics keep their shape and after washing do not need ironing. Nylon is inflammable and not suitable for children's clothes and for saries. Many deaths have occurred from clothes made of Nylon catching fire. Cloth is made from a mixture of Terrylene, wool and cotton (Terry wool, Terry cotton) to take advantage of each. These are suitable for suits.

As to colour, white absorbs heat the least and is consequently the coolest and best for summer, while red and black are warmest. Coloured garments, however, should not be worn next to the skin as poisonous dyes may cause irritation.

While protecting the body from injury, cold and wet, the clothing should be such as not to impede natural movements or constrict any part of the body, but should be light and loose. The dress should hang from the shoulders or hips and not press on the chest, belly, waist or indeed be too tight anywhere. This is to be particularly emphasized in the case of long and close fitting skirts, corsets, garters, bands round the waist and neck (collars).

ill-fitting gloves, hats and boots. It is a well-known fact that the feet of Chinese ladies and of fashionable women generally are often badly deformed on account of ill-fitting shoes.

It is impossible to keep the skin clean without paying sufficient attention to the cleanliness of the clothing, both for the day and the night. At bed-time all the clothes should be changed, the day clothes being hung up to get dried and aired. The night dress should be light and loose and preferably of cotton. For young children, old people, rheumatic persons or in a very cold climate, a woolen night-dress is preferable. The bed-covers like blankets and *razais* should be light and warm. The *razais* should have a removable cover which must be frequently washed. It is a bad habit to cover the face while sleeping, as breathing of the expired air containing organic impurities again and again, and breathing of air vitiated by passing of foul smelling flatus which is likely to contain germs, may prove

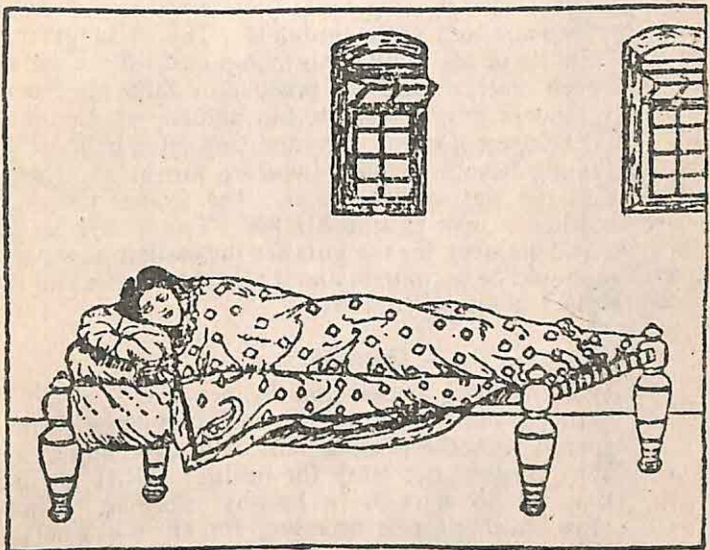

Fig. 19.—How to sleep.

very harmful. The use of bed curtains and other hangings around beds and in bedrooms should be discouraged, as they not only impede ventilation but harbour dirt and dust.

Damp clothes should be changed at once, as being good conductors of cold, they are liable to chill the body.

The supervision of washing does not receive sufficient attention. The *dhobi* is liable to wash clothes in all sorts of water, and in this way the water may become contaminated with disease germs; and the possibility of spread of cholera, dysentery, typhoid and other diseases by its means is quite apparent. Similarly, they may get contagion of measles, small-pox etc., from being stored up with infected clothes in the *dhobi's* room. This may account for many mysterious outbreaks of these diseases. It is a good thing when the clothes come from the *dhobi* to expose them to the sun for some hours.

Early marriage.—The custom of marrying boys and girls at an early age, which unfortunately still prevails among certain classes of people, is a very baneful one, both on hygienic and social grounds. The development of certain parts of the body is not completed till a certain age has been reached, and the practice of early marriage not only hinders proper growth, but actually checks the physical development of the pair: and very often by involving the young boy in needless worries proves a regular obstacle in the way of his career. The proper time to marry is when a man is settled in life. Twenty-five years for boys and eighteen for the girls are the earliest at which marriage should be permitted, and it would be better still if it takes place some years later.

Questions

1. What do you understand by personal hygiene?
2. Write a short note on personal cleanliness, with special reference to skin, hair, nails, eyes, and ears.
3. Why is sleep necessary for health? What condition should exist in a healthy sleeping room? How much sleep is necessary for an individual?
4 Why are games better than gymnastics or exercise taken to the word of command?

5. What are the evils of early marriage? What do you consider as a suitable marriageable age for boys and girls?
6. Write a brief note on the treatment of head lice.

CHAPTER IX

THE HOUSE

DURING the last few years there has been a big increase in the population of India, due to increase in birth-rate, decrease in death-rate and to migration from Pakistan, as a result of partition of the country. This has caused great overcrowding, and in many places conditions were almost like slums. The situation is now being handled systematically, by construction of cheap sanitary houses on a planned basis by the Government. But the real solution of the problem lies in raising the living standard of the people by economic planning on a national scale, for which the government of India has appointed a planning commission, and it is hoped that by large scale building of new cheap houses overcrowding will disappear from big cities, where it is so prevalent in these days.

The *house* depends in its character very much on the wealth and position of the dwellers. It may be a cottage in a village or a palace in the city, but whatever it is, there are certain general principles which should be kept in view before a house is built or rented. If everybody would insist on healthy living quarters, in a short time house-owners would be compelled to build hygienic houses only. Municipal authorities also can do a lot by framing proper building bye-laws and insisting upon their enforcement. When building a house the following matters should receive careful consideration:

1. The site, having regard to soil aspect and surroundings.
2. The construction, including arrangements for ventilation, light, and for keeping the rooms free from damp, and cool or warm as necessary according to season.

3. The drainage and arrangements for removal of waste matter.

The *site* should be dry and the soil permeable. Hence gravel, chalk and sandstone make excellent building sites. Clay soils are damp while sandy soils are too hot in summer and too cold in winter. 'Made soils' that is soils made by filling depressions by refuse etc., are very unhealthy. The aspect should be such as to allow free access of sunlight and air and these should not be kept out by trees or high buildings. The vicinity of ponds, lakes or rivers is injurious. Nor should the house be in the neighbourhood of chemical works, graveyards, brick kilns or heaps of decaying vegetable or animal matter. A few trees, especially if not too near the buildings, are beneficial as they protect it against winds and dry the soil. Eucalyptus trees are particularly recommended.

A house should be so *constructed* that it may be firm, dry, warm in winter and cool in summer, well ventilated, well lighted and with no possibility of ground air entering. it. The walls should be about a foot thick, laid on a layer of concrete, with a damp-proof course near the ground. This course is made of either glazed tiles, slate, sheet lead, or other impervious material such as a layer of coaltar.

Floors are best made of an impervious material, which can be washed, such as stone, tiles or cement. Roofs should be so made that they keep the rooms cool in summer and hot in winter, and do not leak in the rainy season. The commoner roofing materials are thatch, mud plastering tiles set in cement over a layer of waterproof material like coaltar, so as to prevent leakage during rains. This is very satisfactory and is more commonly used in the plains. Thatch is liable to harbour rats and catch fire and is gradually being given up. Mud plastering needs to be done every year and is liable to leakage in the rains. On the hills where the rains are heavy, roofs are made of slanting galvanized iron sheets laid over flat timber.

The general arrangement of the house needs some attention. In no case should back-to-back houses be built, and it possible rows of houses should run facing north and south so as to get sunlight in every room during some period of the day. All the rooms should be so constructed as to get light and air directly from outside. The height of rooms should not be less then nine feet and need rarely exceed twelve feet. Every room should have at least one window in it, which opens direct to the outer air.

The latrines must not be near the kitchen or the sleeping room. The proper place for them is in a separate room or outside the house, and these should be well part ventilated and exposed to the direct rays of the sun. The walls ought to be covered with glazed tiles, distempered, or at least lime washed. The floor may be of tiles or cement. The ordinary latrines are now being replaced by 'flush' or 'water closets' in larger cities.

The question of ventilation and the arrangements for refuse disposal are discussed in separate chapters of this book; there remains, therefore, the consideration of the chief points connected with lighting, cooling and heating of rooms.

The *lighting* of houses and schools is a question which has not received sufficient attention in this country and many houses and schools are so built that they are absolutely devoid of the sun's rays all the year round. When it is remembered that the light of the sun is antiseptic in its action, directly killing many germs and that sufficiency of light is necessary if eyes are to be protected from the evil effects of eye strain, the importance of the subject becomes quite apparent.

In order that a house should get plenty of sunlight, it should have as much space as possible all round it, or if it is one of a row of houses, the street in front and behind should be sufficiently wide. Trees should not be allowed to grow too near the house and as they make it damp and dark and prevent ventilation except if growing at some distance they are pleasant and harmless and protect the house against winds. The principal rooms should face east, south and west so that sunlight may freely enter the rooms.

The window area should be proportionate to the size of the rooms and about one-quarter of the floor area.

All kinds of glazing and colouring of walls which diminish the light should be avoided. Dingy walls and dingy furniture absorb the light rays. The walls should be painted a light colour, the ceiling white and the furniture also ought to be light coloured. A dull smooth surface is preferable to a shiny smooth surface.

The light in the rooms used for study should mainly come from the left, and if that be not possible light from the right may be allowed. In no case should light come from the skylights or from the front. The chief objection to top, back and right lights is that they throw a shadow on the work, while light from the front causes a strain on the eyes.

The house may be *artificially lighted* by electricity, gas, oil, or candles. The best of these is undoubtedly electric light, since it is clean, cool and steady and adds no products of combustion to the air of the room. Moreover, the lights can be easily shaded. Gas is not nearly so good, but if it has to be used it should be in conjunction with incandescent mantles. Unprotected flames are apt to flicker. The ordinary gas burner uses up the air and gives off a large amount of impurity, in fact it fouls as much air in an hour as five or six adults do. The best arrangement is that by which the gas is enclosed in a globe making it independent of the air of the room. Where gas is not available, kerosene oil may have to be used, but it must be remembered that one oil lamp can foul as much air as a gas burner. For reading purposes, in the absence of electric or gas light, the best kerosene oil lamps, provided with proper shades, should only be used. Candles, however, are much dearer than oil for the same amount of light. The ordinary sweet oil *chiragh* (*deea*) so commonly used in the villages is very unhealthy, as not only is the light very feeble but flickering and uncertain.

In India the *cooling* of rooms is desirable in summer. The old custom of having *sardkhana* or underground cellars is to be condemned, as they are ill-ventilated and allow injurious ground air to escape into the cellar. The house as far as possible should be protected from heat by having verandahs, avoiding low rooms and having thick walls and roofing. *Pankhas*, electric coolers, air conditioners, *khus khus tattis* and electric fans are all used for reducing the temperature. A few trees in the vicinity of the house, though not so close as to obstruct light and ventilation, are desirable aids in lowering temperature.

Air-conditioning—In the last few years air-conditioning is justly becoming very popular, and not only hospitals, offices and residential houses are being air-conditioned but so are railway carriages also. Let us, therefore, diseass this subject in greater detail. As mentioned in the chapter on foods, the heat resulting from the combustion of food and production of energy maintains the body temperature at about 98.4°F. by corresponding regulation of heat lost by evaporation of sweat and by radiation. This takes place automatically by the heat regulating mechanism, under the control of a centre in the mid-brain. To assist this body mechanism and to provide comfort to the human body, atmospheric temperature, its cleanliness, humidity, and air movement are controlled by means of *air-conditioning*. This is done by lowering or raising the air temperature to a comfortable zone by means of refrigeration, and by adding or removing the moisture from the air according to the needs of the body. At the same time air is purified by the removal of such substances as particles of earth, sand, animal and vegetable matter, smoke, etc., which are always more or less present in the atmosphere.

The *heating* of rooms is not necessary in this country except for a few months during winter. As a general rule the temperature of a sitting-room should be about 60° to 65°F. The principal methods used for heating rooms may be classed as either open fires, closed fires or stoves, and pipes containing either heated air, hot water or steam. Electricity is also being utilized for this purpose, in electric heaters, stoves, radiators or air conditioners.

Open fires are the means most largely used in this country. The air retains an agreeable degree of moisture, the draught created in the chimney helps to ventilate the room, and the appearance of an open fire is bright and cheerful. The chief disadvantages are that an open fire is wasteful, and heats the different parts of the room unequally.

No house, however well-built, will be healthy unless it is *properly kept*. The walls of the house may be either painted or papered, but preferably they should be lime-washed or distempered. As regards papering care must be taken that the paper contains no arsenic in the colour, as this will gradually be given off and poison the air of the room. If lime-washed at least once a year, the surface should be well scraped and whitewash applied, the aim being the removal of bacterial life, rather than its burial even under a germicide.

The floor may be covered by a carpet in the form of a square, leaving a margin all round. It is more easily taken up, shaken and cleaned. The use of cow-dung as a covering for floors is an unhealthy practice, as it attracts flies and is a favourable breeding ground for germs. Mud floors should have the surface earth dug up and removed at least twice yearly, and fresh mud laid and beaten until quite smooth.

The furniture should be easily movable, so that the space underneath can be regularly cleaned. Book-cases and cabinets with flat tops are easily dusted, but those with hollow tops only collect dirt. The room ought not to be overfurnished and woolly and fluffy articles of decoration, heavy draperies, fittings, and ornaments, which will harbour dust and render it difficult of removal must be avoided. Flies may be kept out of the house by using chicks or by using wire gauze doors and wire gauze windows. Regular cleaning is essential to keep a house in a proper condition. The house and furniture should be dusted daily, the floor swept, not neglecting the corners, and all cobwebs removed from the corners and the roof. At least twice a year, if not more frequently, all the furniture should be removed and put in the sun, the walls whitewashed, the wood-work polished or at least washed with soap and water.

Drains.—Connected with the sanitation of the house is the sanitation of the *mohalla* or lane in which the house is situated. Though the cleanliness of the streets and lanes would be under the charge of municipal sweepers, whose work is supervised by sanitary inspectors, the householders should co-operate by seeing that no rubbish is needlessly thrown into the street, after it has been cleaned. Such rubbish should always be deposited in galvanised iron dust-bins from where it may be conveniently removed by the municipal sweepers. Open channels or *parnalas* leading from privies and bathrooms on the top floors of the houses are a great nuisance and ought to be replaced by proper drain-pipes made of iron.

Drains passing along the streets should be pucca, as leaky drains may be a source of spreading infection. In most towns and villages there are open drains. No improper use must be made of such drains by throwing rubbish or excreta into them or by letting children ease themselves in them. There should be proper arrangements for flushing drains.

It is best, however, that drains should be covered and preferably be underground.

Questions

1. What general principles should be observed in building a house?
2. Write a short note on the heating and cooling of rooms.
3. From which direction should light come? Why is reading in railway trains and while lying down in bed harmful?
4. Compare lighting by electricity, kerosene oil, candles and the *chiragh*.
5. What do you understand by Air-conditioning?

CHAPTER X

REFUSE AND REFUSE DISPOSAL

HOUSE refuse consists of:—

(*a*) The excreta, i.e., urine and fæces.

(*b*) Kitchen refuse such as ashes, leaves, straw, sweeping of floors, stale fruit, vegetables, etc.

(c) Waste water from house cleaning, washing and cooking

Refuse must never be allowed to collect anywhere in or near a dwelling. House yards, compounds and streets should be swept clean of all refuse every day, and all kitchen refuse placed in a dust-bin and covered with a lid till removed. Broadly speaking, there are two systems of dealing with these waste-matters, the *conservancy* or *dry system* and the *water carriage system*.

In the *conservancy* system, the greater part of the kitchen refuse ought to be burnt in the kitchen fire. What cannot be burnt should be put in the dust-bin and the contents removed by the municipal authority. Similarly, the excreta are collected in pails and removed by the sweeper to the municipal refuse cart. The chief methods employed for the disposal of refuse are the following:

1. *Dumping.*—Depositing upon waste or low lying lands and filling up pits of excavation or raising the level of marsh lands. These 'made soils' should not be used for building sites as they are very unhealthy.

2. *Using as manure* to promote the growth of crops.

3. *Compositing.*—This is made from vegetable waste, cow dung, cow's urine and night-soil by putting them in special trenches. These break up into brown mass compost which is used as manure. In this process there is no danger of fly breeding.

4. *Destruction by fire.*—The refuse is mixed with dry leaves or wood, burnt in an incinerator and reduced to clinker, metallic refuse and dust.

For a proper working of the dry system it is necessary to have well-built latrines, fitted with glazed *gumlahs* or tarred iron pans. Latrines should always be placed on an impermeable base, must have free ventilation and the sun's rays allowed to play upon the whole of the inside. The night-soil and the urine ought to be collected separately, as decomposition sets in rapidly if they are mixed.

Water-tight receptacles for night-soil and water-tight filth carts must be provided. The night-soil and other refuse should be promptly removed from the town and applied to the agricultural land as described below, or burnt in an incinerator.

Trenching.—Trenches to receive the excreta should be properly made, two feet wide, one and a half feet deep, with one foot between each trench. The night-soil is placed in them to a depth of nine inches and then the trenches are filled up with earth. If the trench is more than two feet deep, proper decomposition does not occur, as the bacteria which decompose night-soil are not found deeper than this. Three months after trenching, the ground should be ploughed and sown with rapidly growing crops. The trenching system works badly in the rains as it is difficult to get dry earth. There is also great difficulty in the disposing of liquid waste matter which often needs a separate system of drains. And above all, it needs an efficient system of scavenging and a proper supervision of sweepers.

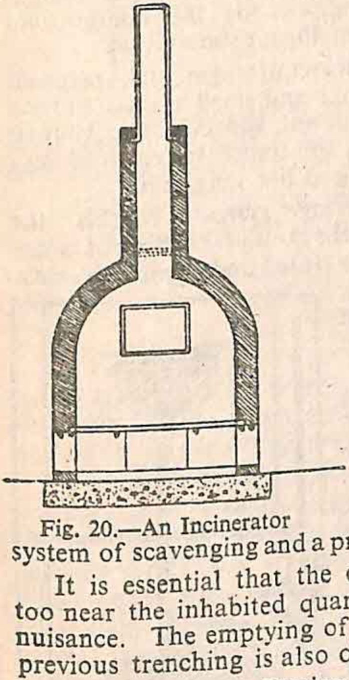

Fig. 20.—An Incinerator

It is essential that the cultivated area should not be too near the inhabited quarters, otherwise flies become a nuisance. The emptying of filth-carts into fields. without previous trenching is also open to serious objection.

Trench latrines.—During fairs, etc., *trenching* is utilized as *trench latrines* by digging long trenches 18 inches deep and 9 inches wide. The person using it places his feet on each side of the trench in such a manner that the urine, excreta and ablution water fall in the trench. After use these are filled up, and cultivated in about three months.

Bore-hole latrines.—These are circular holes 12 to 15 inches wide and deep enough to penetrate with the ground water. When they fill up to about $2\frac{1}{2}$ feet from the ground level they should be filled up with dry earth. They are suitable for rural areas.

Incineration or destruction by fire.—This method of disposal of refuse requires the construction of a properly designed incinerator, a liberal supply of fuel, a mixing platform, and a storage godown for the combustible material, as well as constant intelligent supervision.

The chief difficulties with incineration are (*a*) the disposal of fluids, (*b*) the excessive smoke and smell associated with it, and (*c*) the need of constant supervision. Though cheaper in its initial cost than the trench system it is very doubtful if it effects any saving in the long run.

The wet or the water carriage system.—In this the excreta are taken away from the house by a flow of water which carries them at once into closed underground drains. For big towns, it is by far the best, cheapest, cleanest and most rapid method of refuse removal.

Instead of ordinary latrines there are *water closets*, i.e. seats with basins of water connected with them to wash down the excreta, and there are drains connecting the closets with the underground sewers or pipes which lead the excreta away from the town.

The success of this method depends on there being a plentiful supply of water, properly constructed sewers with good ventilation, and a good outfall and the proper disposal of sewer water. The system is in vogue in many big towns, and ought to be introduced in other large towns also.

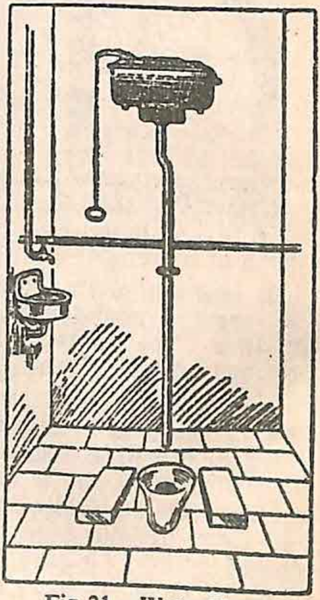

Fig. 21.—Water Closet (Indian type).

Sanitary baths and wash basins are now fitted in many houses where plenty of water is available, and modern types of urinals with flush are found in big establishments like schools, colleges, offices, etc. Such urinals and flush latrines should be provided by the municipal authorities for public use on all important roads and streets to prevent people from urinating and defæcating in side drains, road corners, etc.

The ultimate disposal of sewage : This is still one of the most difficult questions of the day, and among others the following plans have been suggested :

1. Discharge into the sea, as in Bombay.

2. Discharge into rivers, lakes, etc.

It is a dangerous method and many epidemics of cholera and typhoid have been caused by the pollution of river water.

3. Use for irrigation purposes.

To ensure success there should be a large enough area, and well drained, intermittent passage of sewage and a succession of rapidly growing crops.

4. Treatment by chemical precipitation.

Lime is commonly used. The precipitated material known as sludge is either used as manure, burnt, or discharged into the sea. This is a costly method and there are difficulties in the disposal of sludge.

5. Biological treatment in septic tanks.

This method is based upon the presence in sewage of micro-organisms which can convert solid excreta into harmless liquids and gases by a process of fermentation. For this purpose large tanks are built. Before being taken into the tanks, the sewage is passed through a 'grit chamber' to allow stones, or other heavy particles to settle down. When the sewage has remained in the tank for some time a leathery scum forms on the surface; below this is the zone of fermentation, permeated by bubbles of gas which constantly keep rising, and maintain a quiet movement throughout the fluid; at the botton is a small layer of peaty material. Small masses of organic matter fall to the bottom by their own weight, but when they reach the bottom, gas is evolved from them by bacterial action and the particles are floated up again and at the surface the gas bubbles burst, and the solid matter again sinks. This cycle is repeated, until practically the whole of the suspended solid material is liquefied through bacterial action.

The gas generated in tanks has been used for lighting and power purposes.

The effluent though clear and odourless is potentially dangerous and should not be discharged into rivers. The best method for its disposal is to pass it on to cultivated land.

The method is now being used more and more in the larger towns of India, and is recognized as a simple, practical, efficient and economical means of sewage purification.

Questions

1. What are the various kinds of refuse found in houses? What methods are adopted for refuse disposal, and which do you consider the best.
2. Describe an incinerator.
3. Describe a good latrine. In what part of the house should it be built.
4. How should excreta be disposed of? What do you understand by 'made soil'?

CHAPTER XI

INFECTIOUS DISEASES

DISEASES which are caused by the introduction of germs into the body are known as infectious diseases. Different diseases are caused by different kinds of germs. Germs are conveyed from one person to another in a variety of ways—by direct contact with the sick person, by air, water, food, soil and through the agency of insects. Some diseases are conveyed in more than one way, for example typhoid fever is ordinarily conveyed through water or food, but the germs of the disease may also be mechanically carried by insects such as flies. The investigations of scientists and the experience of other nations have proved that if proper measures are adopted all these diseases are preventible. It would be no exaggeration to say that nearly 90 out of every 100 deaths in India are due to diseases caused by germs and can be prevented if the people only knew how to do so. The general methods for the control of infectious diseases consist in immunisation of the healthy by vaccination and improvement in general sanitation.

Bacteria.—'Germs' is only a popular name for the tiny living organisms that cause many diseases in men and animals. Many of them belong to the vegetable world and are called Bacteria. The plants with which you are most familiar are green and love air and sunshine. They obtain food for themselves from the water sucked up by their roots and the air absorbed by their leaves. But there are other plants like *Amar bel* (*Cuscuta*) which often grow on *Ber* trees, and suck their food ready-made from the tree on which they grow. There are still others that are not green at all. Such are the mushrooms and moulds. The common mushrooms live and grow on soil in which pieces of dead leaves, decaying wood and bark are mingled, and it is from this material that they obtain their food. If a slice cut from a fresh loaf of bread is exposed to the air for a while and then covered up by a jar inside which a dish containing a little water is also enclosed, so that the slice cannot get dry, within a few days it will be covered with a growth of white thread-like bodies, which are living plants, familiarly spoken of as mould, and the bread is said to have grown mouldy. After a few days the mould is seen to bear small, black heads which yield a fine dust-like powder. These dust-like particles are called *spores*. These spores are so light that they are easily blown about by the wind, and any of them settling upon a piece of bread or any other suitable object is able to grow into a new mould plant. You may have seen mould growing on various other things, for example on wet boots laid aside for two or three days during the rainy season. In all cases the growth is due to tiny spores floating about as particles of dust in the air, and settling on the things.

Bacteria, like moulds, are plants that live and grow on suitable organic media. They are, however, so minute that they can only be recognized with the help of a powerful microscope magnifying about a thousand times, the average thickness of a bacterium being 1/25,000 inch, that is to say, if an army of 25,000 of them marched abreast, they would only cover an inch of ground. No wonder then that the average person knows nothing of the working of these tiniest of tiny beings. A simple experiment may be performed to see colonies of bacteria. Put a small quantity of meat broth stiffened with gelatine or agar in a test tube, and immerse the tube in a water-bath of boiling water to a level above that of the liquid in the tube, and allow boiling to continue for at least thirty minutes to destroy any living things that may already be present in the medium. Then pour the liquid into two shallow dishes, so as to form a thin layer in each, and cover them. Expose one of these dishes to the dust of the air and allow it to remain so for about fifteen minutes. Then cover again. The other dish should not be uncovered at any time. Leave the two dishes for several days and then look at them. It will be seen that the gelatine in the dish which was exposed to the air has upon it a number of small round spots, which grow bigger from day to day (Fig. 22).

If a little of the matter forming these spots is now examined under the microscope, it will be seen to consist of thousands of very minute objects, which are so small as to be just visible with the aid of the microscope. These minute objects are living plants of the simplest structure and are called bacteria. It is obvious that each bacterial colony resulted from the multiplication of one bacterium which fell upon the gelatine at the point where a colony has developed, while it was exposed to the air. Thus we learn that bacteria are living things, and like other living things grow and multiply and that they are present everywhere. One single bacterium in favourable conditions will soon form two, and then four, and so on with amazing rapidity, till they become millions.

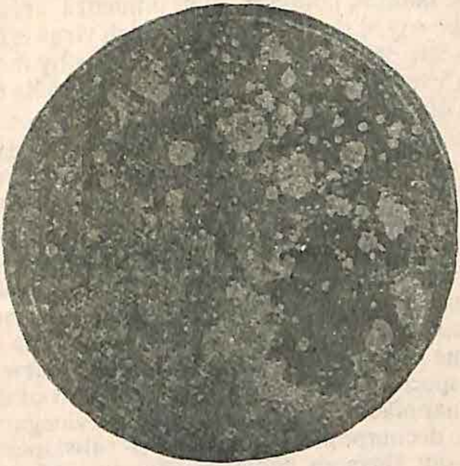

Fig. 22.—Colonies of bacteria. Each of the circular or irregular patches represents one colony of bacteria. The bacteria grew in a thin layer of nutrient agar in a dish. The colonies have arisen from the multiplication of bacteria which fell upon the agar during fifteen minutes' exposure out of doors. (*From Caldwell* and *Eikenberry's Elements of General Science*, Published by Ginn & Co.)

Viruses.—Viruses are smaller than bacteria. These are tiny particles of living matter that can pass through porcelain filter while bacteria cannot do so. Viruses are ultra-microscopic i.e. they cannot be seen by optical microscope, but can be seen by Electron microscope. Viruses are intracellular parasites. There are different viruses which cause different diseases. Virus is conveyed from one person to another by droplet infections i.e.when a person speaks, coughs, sneezes, droplets of moisture are spread out and any person within a radius of 6 to 10 feet will get the infection. Other droplets fall on the ground and when the ground is swept, the dust is breathed and virus enteres the blood. Similarly infection can be conveyed through the medium of objects infected by the sick person such as by attendants, their clothing etc. Chief diseases caused by droplet infections of viruses are small pox, meales, mumps, common cold, influenza, chicken pox, anterior polio-myellitis. Diseases in which virus is conveyed through the bite of an insect are dengue fever by mosquitoes and sandfly fever by sandflies. Rabies is generally conveyed by the bite of an infected dog.

Bacteria as our friends and foes.—There are many different kinds of bacteria and we see signs of the activity all round us. They not only feed, grow and multiply, but bring about vast changes in the composition of the substances on which they grow. Milk left to itself becomes sour. If a small quantity of curd is mixed with milk and the whole left overnight, by next morning the whole of the milk is changed into curd. If curd is pressed and left in a muslin bag for some time, it becomes cheese. All these changes are due to special bacteria. Bacteria are also of direct use in many manufacturing processes, as in vinegar making. Decay and decomposition of various substances is also brought about through bacterial activity. Meat left too long becomes bad, an animal carcass gradually begins to decompose; a heap of leaves or other rubbish gradually rots; all these processes are due to working of bacteria of different kinds. Very often the processes of decay and discomposition come prominently to our notice through the bad odours which are set free, which afford clear evidence that some sort of chemical change is taking place. In all these cases bacterias prove useful to us.

Some kinds of bacteria find their suitable conditions in our bodies, and are able to live and multiply, and set free the products special to them. Many of them produce more or less serious diseases. Some of these diseases are directly communicable from one person to another, by breath, coughing, sneezing or even loud talking; or from the clothes or in many other ways by which bacteria are directly transferred from a sick person to those who are near him. The bacteria so transferred find a fresh ground on which to thrive, and another person catches the same disease. Disease-producing bacteria are also distributed through the agency of air, water, food, or various insects which may either mechanically carry them on their legs, wings, etc., or harbour them inside their body and introduce

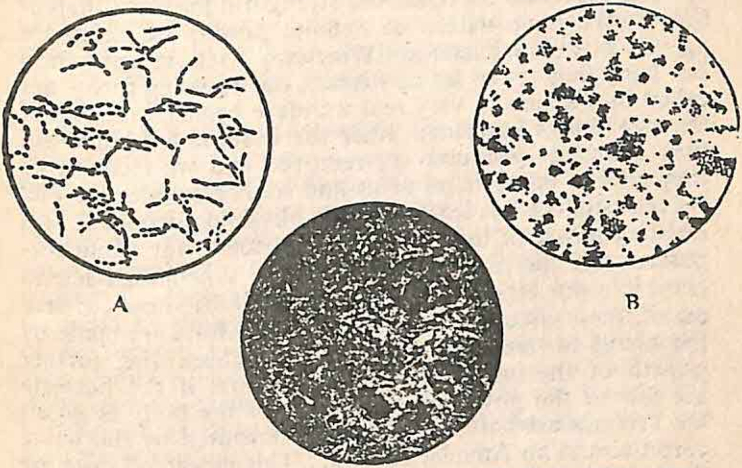

Fig. 23.—A and B—Pus-producing germs. C—Tubercle bacilli in the sputum of a person suffering from consumption. The bacteria are so small that special methods of staining are used to render them recognizable under the microscope. *(From Wellcome's Medical Diary by permission of Burroughs Wellcome & Co.)*

them into the blood of healthy persons by their bites. Such diseases, however transferred, are known as 'infectious' or communicable diseases, and the absence of proper checks often assume an *epidemic* form. When the epidemic is spread over a large area in several countries it is known as *pandemic.*

Resisting Power and Immunity.—The question is often asked why if infectious diseases are due to bacteria, some people catch the disease while others equally exposed to infection do not, and of those attacked only some die and others survive. A man's chance against an attack of bacterial disease depends upon the number of bacteria introduced into his body, on the virulence of the bacteria, and on the resisting power of his body, just as the conquest of a country depends upon the character and strength of the people who are invaded. The bacteria of some diseases are deadlier than others, and apart from mere numbers, in the same bacteria the strength differs at different times. We have within us definite powers of resistance against invading bacteria. Whenever bacteria enter into our body they try to set up disease, our resisting forces are called into action, a very real warefare begins, and one of the two things happens: either the bacteria are killed off, their harmful products are removed and we recover, or they get the upper hand of us and sooner or later we die. As the student has learned in his physiology course, this resisting power of the body is chiefly due to the white corpuscles and the plasma of the blood. Whenever bacteria enter into our blood, certain poisonous substances are produced, these circulate in the blood, and efforts are made by the blood to neutralize them and to check the further growth of the bacteria. In this warfare, if the bacteria are few or the power of resistance of the body is great, the bacteria are actually killed and devoured by the white corpuscles in an Amœba fashion. This power of resisting disease possessed by the body is known as *natural immunity* but in the case of some diseases, for example, measles, one attack of the disease leaves the body stronger to resist subsequent attack of the same disease. This is called *acquired immunity*. By *vaccination*, the body obtains acquired immunity against small-pox; and on somewhat similar lines, successful inoculations against typhoid, plague, cholera, diphthera, whooping cough and certain other diseases have also been introduced, which confer immunity for longer or shorter periods on the person undergoing the inoculation. This is called *Immunization*. The time that elapses between the entry of the germs into the body and developing of symptoms is known as the *incubation period*.

Other habits of germs.—Like most plants, germs want plenty of moisture; and like all plants they die if they get none. A moderate degree of temperature suits them best; but excessive heat will kill them. Unlike most plants they do not want sunlight but on the contrary are killed by exposure to it. The living bodies of men and animals serve as a suitable soil for some, whilst dead or decaying matter, dark dingy and damp houses, are ideal places for most others. Anything nasty, like refuse, rubbish heaps, stale food. filth and dirt of all kinds is their favourite ground and we should have none of them in or near our houses. Sunlight and fresh air should be freely admitted into our houses to kill deadly germs.

Diseases which are caused by the introduction of germs into the body are known as *infectious diseases*. Different diseases are caused by different kinds of germs. Germs are conveyed from one person to another in a variety of ways—by direct contact with the sick person, by air, water, food soil and through the agency of insects. Some diseases are conveyed in more than one way; for example, typhoid fever is ordinarily conveyed through water or food but the germs of this disease may also be mechanically carried by insects, such as flies. The general methods for the control of infectious diseases consist in immunization of the healthy by vaccination or inoculation, isolation of the sick, and by general sanitation.

DISEASES CONVEYED BY DIRECT CONTACT

The germs may enter through the unbroken skin but the infection takes place more readily through a cut or abraded surface of the skin. The more important of the diseases transmitted in this manner are:

Ringworm[1].—This is a very contagious disease caused by a vegetable parasite (fungus). The fungus may attack at hair of the scalp (commonly in children) or other hair parts of the body. The part affected shows circular bluish patches, covered with the white scales, the hairs are withered and dry and there is severe itching. It is commonest in children of school-going age. This fungus also attacks interdigital spaces between the toes, the groins and the armpits and causes redness of the parts and severe itching. The disease is conveyed through a number of children using the same comb or towel, etc, or through the insruments of the barber being infected. Prevention of the disease, therefore, lies in prohibiting the use of combs, towels, etc., of the sick by healthy persons. For treatment a qualified physician should be consulted.

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[1] Hindi, *Dadru*

Tetanus.[1]—It is caused by a germ which lives in the intestines of herbivorous animals and is passed out in large quantities in their dung. The infection occurs by contamination of skin wounds by richly manured soil, or by pricking of feet by shoe-nails. Disease is characterised in spasms of face muscles which spread to other muscles of the body. Prevention consists in giving injection of anti-toxin when there is possibility of wound infection by garden soil or road sweepings. Active immunity is obtained by injection of Tetanus toxiod, three injections at monthly intervals beginning at 6 months of age followed by an injection at one year and at the time of injury.

Ophthalmia[2].—This is a disease characterised by pain, redness and watering of the eyes. The infection is generally conveyed by using towels, handkerchiefs, etc. which have been used by a person suffering from the disease, and the prevention lies in other persons not using such articles till after they have been properly disinfected and washed. If one eye is sore, the infection is very often conveyed to the other eye also.

Treatment.—The treatment consists in frequently washing the eyes with boric lotion, and *putting twice a day a drop or two of a* ½ per cent zinc sulphate or 1 per cent silver nitrate solution.

Trachoma or granular lids[3].—It is very common in children in villages, is very chronic and if not properly treated leads to serious eye troubles and even blindeness. The modes of spread and prevention are the same as for ophthalmia, described above. The treatment takes quite a long time and should be done either in a hospital or by a competent doctor.

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[1] Hindi, *Dhanustamb*
[2] Hindi, *Ankkon ka dukhne ana*
[3] Hindi, *Kaniyugakosh*

Leprsoy[1].—It is caused by a bacillus which is best demonstrated in the tissues and in nasal scrapings. It is a typical example of a contagious disease. Infection follows close contact over a prolonged period. These are two varieties, the nodular and the anæsthetic. Course of the disease is very slow. There is no pain. Nodules may ulcerate and muscular paralysis supervene causing deformities of hands and feet and changes in the nose and ears. Segregation humanely carried out is the best prevention. Treatment is successful if started early and carried out patiently over months.

Hydrophobia or Rabies[2].—This is a disease characterised by the muscles of the throat and larynx assuming a contracted form so that the patient has difficulty in drinking water, hence the name *hydro*, water and *phobia*, fear. The infection is caused by a virus and is present in the saliva of the rabid animal.

The disease is contracted through the bite or even licking of a rabid animal, generally a dog, that is a dog which is suffering from the disease itself. It takes twenty to sixty days after the bite for the symptoms to develop, the time being shorter if the bite has been on a bare area or on an area rich in sensory nerves, such as the face and the head. Once the symptoms have developed the disease is invariably fatal. The only chance for life lies in preventing the disease from developing, by proper treatment, at the time of the bite, followed by prophylactic treatment at one of the anti-rabic centres. The treatment, at the time of the bite, consists in ligaturing above the wound, incising and then bathing with hot water and rubbing in potassium permanganate, solid silver nitrate, or pure carbolic acid. But the persons must in all cases receive prophylactic treatment at an anti-rabic centre as prompt treatment prevents the disease from developing. Anti-rabic centres are now located in all District Civil Hospitals and tahsel-hospitals.

The treatment usually takes fourteen days. Indigent patients bringing a letter from a local official, such as

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[1] Hindi, *Kusht*

[2] Hindi, *Jal Tras Roag*

Zaildar or a *Patwari*, certifying to their poverty, are paid railway fare and diet money for their stay, during the period of their treatment. Application for this should be made to the Civil Surgeon or the Deputy Commissioner or, in their absence, to the Tahsildar of the Ilaqa. Government servants can get an advance from their salary and special casual leave for purposes of proceeding to an anti-rabic centre.

Small-pox[1].—This is a dangerous disease characterised by fever followed by an eruption on the skin which appears on the third day in the form of small red pimples. As the pocks ripen, the skin swells more or less, and thus the eyes become closed. About the eleventh day, the pustules burst, and three or four days later the scabs begin to dry and fall off, leaving behind pits or scars on the skin. For lack of proper care and treatment, most cases prove fatal and many persons are rendered blind. The disease is conveyed by direct contact, by the scabs of the skin flying about in the air, by the clothes of the patients spreading the infection.

Small-pox is now fairly common in India. It attacks persons of all ages. One attack gives immunity, that is a person who suffers from the disease and survives has very little chance of getting the disease again. Similar protection against the disease can also be easily secured by being vaccinated. The period which may elapse between a person catching the infection and developing the symptoms is known as the *incubation period* of the disease, and in this case is generally ten to twelve days. Small-pox is exceedingly infectious throughout the whole course of the attack and for six weeks after, that is, till every scab has fallen off and the sores are healed. During this period the patient must be isolated and all the clothing and everything else coming in contact with him should be carefully disinfected (see chapter on 'Disinfection'). The scabs as they come away should be burnt. During convalescence it is a great danger to the community to allow children with sore before healing to walk about the streets, and the practice of taking a child to the *Sitla Mandir*, just a few days after he is beginning to get well, should be condemned. They must be kept strictly separate from other children for at least six weeks after the attack. All persons who have to come in contact with the patient should be re-vaccinated.

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[1] Hindi, *Chechak* or *Sitla*

Vaccination is the introduction of the virus of the 'cow-pox' into man. This was first discovered by a famous English physician named Jenner, who had so much faith in its efficacy that he vaccinated his own son before vaccinating other people's children. It is now performed by making a few scratches with a lancet and rubbing into them vaccine-lymph which has been taken from a vaccinated calf and prepared in the following manner. Young calves are taken, their bellies shaved and calf-lymph rubbed in after scratching. On the sixth day vesicles are formed. They are taken away well ground with water and glycerine, and afterwards either vapour is passed to kill all extraneous germs. The lypmh is now issued to the doctors and to the vaccination staff, in small tubes for use as required. They should keep it in refrigerators or in an ice box and taken in a thermos containing ice by vaccinators when they go out for vaccinations.

If properly performed, vaccination gives immunity against small-pox lasting for three to five years, after which the person should be re-vaccinated. To be on the safe side during epidemics of small-pox, everybody should be re-vaccinated. In all States it is obligatory on all parents to have their children vaccinated before they are six months old. Vaccination is now available in all parts of the country, and parents are to blame, if they let their children suffer from small-pox, by neglecting this simple, safe and inexpensive safeguard; for vaccination and re-vaccination application should be made to the Medical Officer of Health, who will send a vaccinator for the purpose or the child taken to the vaccination centre, generally located in the municipal office.

DISEASES CONVEYED BY AIR

Disease germs are spread through the air during coughing, sneezing and even loud speaking, by droplets of saliva in coughing and speaking and of mucus in sneezing. Hence these are called *droplet infections.* The important ones are:

Measles.[1]—This is another infectious disease, though not so fatal as small-pox. It is characterised by cough, fever, and a bluish red rash, appearing first on the forehead and later spreading over the whole body. It is a most contagious disease, so much so, that if in a house one child gets an attack, others are almost certain to get it. It is generally conveyed by air or direct contact, the infection being present in secretions of the nose, throat and respiratory passages, even before the rash appears, and there is danger of others catching the infection till the rash disappears. The child should be kept in a separate room into which no other children are allowed, for three weeks from the commencement of the attack. It is very common in India especially in winter and early spring, and generally attacks children. The incubation period is ten to twelve days.

Precautions for prevention are similar to those given for small-pox. New effective measles vaccine has recently been prepared. One attack does not confer complete immunity from a subsequent attack.

Whooping Cough.[2]—This is characterised by fever with fits of coughing which end in a long-drawn 'whoop'. The infection is present in the sputum and is given off by coughing. It is very contagious, the contagion being present even before the cough appears. It is fairly common in India and mostly affects infants and young children. The incubation period is seven to ten days.

The child should be isolated from other children as long as the disease lasts. It usually runs its course for at least one month and the child, if properly looked after, begins to get well after that period. Prophylactic injections with whooping cough vaccine, three injections at monthly intervals, beginning at 2 to 6 months of age give protection in about 90% of cases.

Mumps[3]. —This is an infectious disease characterised by fever and swelling of the salivary glands. The disease is very contagious even from the outset and infection is present until swelling disappears, for which period the patient should be isolated. The infective matter is present in the saliva and breath and is conveyed by direct contact, air and clothing. The disease chiefly affects children and young adults and occurs in an epidemic form in spring and autumn. The incubation period is two to three weeks. Precautions for prevention are similar to those for other diseases conveyed by air. Mumps convalescent serum or mumps gamma globlin reduce complications like orchitis (inflammation of testes).

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[1] Hindi, *Masari*

[2] Hindi, *Kukur Khansi*

[3] Hindi, *Gulsua*

Tuberculosis[1]. —This is an infectious disease (which may be acute or chronic) characterised by fever, wasting, and special symptoms depending upon the part affected. It is caused by a germ known as the tubercle bacillus. The germ may attack any and every part of the body, lungs, alimentary canal, lymphatic glands, bones, joints, etc. When the lungs are affected, it is known as phthisis or consumption when the lymphatic glands in the neck are involved, it is called scrofula. In phthisis and scrofula, the infection is conveyed through breathing infected air, or the germs setting on the tonsils and thence making their way to the lungs or the glands through the lymphatio channels. In the case of tuberculosis of the alimentary canal, the infection is conveyed by swallowing germs, as by drinking from an infected cup, or eating food which has been infected by flies and dust, or drinking the milk of diseased cows.

The disease is not directly transmitted from parents to children or inherited; but unless special care is taken, children of tubercular persons are liable to get it, not only because they live constantly exposed to infection, but also because they inherit a certain predispostion, their bodies being weak from birth.

The germs are thrown out in large numbers in the expectoration of a patient, as many as 4,000,000,000 in 24 hours. Once the sputum becomes dry the germs are scattered about as particles of dust. Patients, therefore, should not be allowed to spit on floors or streets, but into small bottles called spittoons, containing carbolic acid lotion of 1 in 20 strength, or in paper handkerchiefs which should afterwards be burnt. In this way all the millions of germs coughed out by the patient daily, will be effectively destroyed. Cups, spoons and other utensils used by him should be kept separate for his exclusive use and not used by anybody else. They should be washed daily with boiling water.

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[1] Hindi, *Kshay Roag*

The tubercle bacillus is readily killed by exposure to sun, moist heat and by acids, but in the dried state it can retain its vitality for a long time, in dust, sweepings, or sticking to the bodies of flies, etc. By adopting the simple precautions mentioned above, these bacilli can be easily destroyed, and the chance of the spread of disease from a sick to a healthy person greatly reduced.

A large number of tubercle bacilli are breathed in or swallowed with food by every one and it is estimated that 'probably fifty, sixty, seventy or even ninety per cent of the general population suffer or have, at some time or other suffered from tuberculosis. It is also known that tuberculosis contracted in infancy may lie latent for many years. But this latent tuberculosis only assumes an active form if the body becomes somehow weakened. The factors which in-

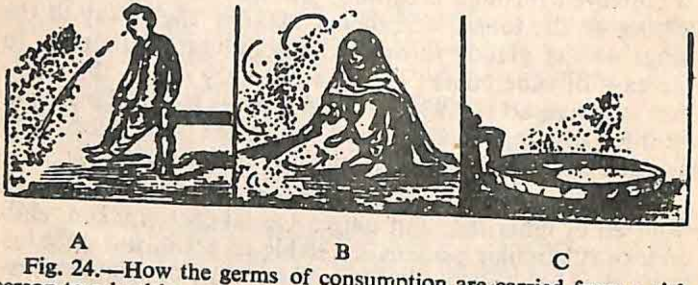

Fig. 24.—How the germs of consumption are carried from a sick person to a healthy one.

(A)—A consumptive patient spits on the floor. The sputum dries up. (B)—By sweeping the floor, the germs get mixed up with the air as particles of dust and may be inhaled. (C)—The food may be infected by the patient and a healthy person partaking of food with him may get the disease.

crease the vitality of germs or lower the resisting power of the body against them are known as *predisposing causes.* In the case of tuberculosis they are insanitary conditions, such as want of sunlight and fresh air, damp soils, overcrowding, and bad ventilation favouring the growth of bacilli; weak chests, dusty occupations, such as those of sweepers, miners, etc., and weakness resulting from previous infections such as influenza, pleurisy or whooping cough by affording a suitable soil for the germs that enter the body. In addition to these, overwork, worry, chronic starvation, intemperance, malaria, etc., increase the susceptibility of the individual by lowering his general vitality.

Prevention of this widespread disease depends on the education of the people in the elementary laws of hygiene, so that they may realize the importance of sanitary conditions, increase the vitality of the body and its resisting power against germs, and see that while proper care and treatment are bestowed on a patient, no infection is spread from him to others. Recently, inoculation by B.C.G. Vaccine has proved successful in preventing tuberculosis. This should be done in childhood.

Tuberculosis is so difficult to recognize in its early stages and so chronic that a patient may sometimes suffer from it for years, without knowing that he has it. The complete segregation of sufferers is therefore almost impracticable. The modern treatment of tuberculosis by prolonged administration of combination of drgus in conjunction with a well regulated programme of bed rest, nourishing food etc. has given better results than treatment in sanotaria. The patients naturally prefer to be treated at home among their friends than at expensive sanatoria away from their homes, especially as the results of treatment at home are as good and even better than in sanatoria. Treatment of poor, illiterate, ignorant, open cases in homes crowded with children is a danger to the community. These should be treated in T.B. Hospitals.

Pneumonia [1].—This is an acute and always a serious disease. It is an inflammation of the lung substance which results in blocking of the air-cells, causing interference with breathing, and preventing oxygenation of the blood.

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[1] Hindi, *Phuffus shoth*

The disease is caused by an organism, the pneumococcus, which exists in the sputum and which may be carried by the air. Cold and a low condition of health render a person liable to contract the disease.

The symptoms are high fever, pain in the chest, and sometimes the expectoration contains blood.

The preventive measures consist of avoidance of draughts in the cold weather, undue exposure, and insufficient clothing.

A physician should be immediately consulted and the treatment carried out.

The Common Cold.—The "common cold" is inflammation of the upper respiratory tract due to virus infection or is an allergic reaction caused by inhalation of poller or dust.

Epidemics of common cold mostly occur in the winter months, partly due to the unhygienic conditions which prevail in winter, like overcrowding and bad ventilation, and partly due to the fact that severe cold, chilling and dampness cause lowered resistance of the body tissues.

The symptoms of cold are well known. There is burning sensation, pain and running of the nose. There is also headache, general pain and ache in the back and limbs; shivering and slightly raised temperature.

The infection spreads directly by coughing and sneezing from individual to individual, and those people who are debilitated by the effects of chilling and dampness are more likely to get infected than others who enjoy robust health.

The common cold may last for a few days only, but it may persist for a longer time, and then lead to serious complications like bronchitis, laryngitis and penumonia.

So a cold should not be neglected.

The preventive measures are avoidance of crowded places like cinemas during the epidemic, suitable clothing, regular and healthy diet, and keeping away from dust.

During the attack, one must stay in bed, use a handkerchief while coughing and sneezing, and consult a physician.

Influenza[1].—It is an infectious disease, spreads from person to person mostly by contact, though sometimes by attendants on sick persons, infected clothing, towels, etc. Overcrowding, fatigue and a dusty atmosphere favour infection. The virus of the disease is very minute and enter the body through the nose. The period of incubation is very short, and thus the disease spreads rapidly. The onset is sudden, with chill, fever, and pains in the head, back and legs. The chief dangers lie in the spread of the disease to the lungs causing pneumonia, and its effect on the heart and the nervous system producing extreme weakness.

Prevention lies in avoiding overcrowding, fatigue and a dusty atmosphere. The body should be protected against cold. Living in the open air as much as possible, and keeping the doors and windows open when in the house or in the office is one of the best means to diminish the risk of infection. Influenza virus vaccine gives temporary protection and should be given at the onset of an epidemic.

Cerebro-spinal Fever[2] (Epidemic meningo coccic meningitis)—It is a disease in which there is inflammation of the membrane which covers the brain (*meminges*) and the spinal cord due to a small germ. The germs enter through the nose and settle in the naso-pharynx from which they travel to the brain through the blood. The incubation period is three to seven days. Sometimes healthy persons who have come in contact with the patient carry these germs in their throat, without themselves suffering from the disease. Such persons are called healthy *carriers*. The disease spreads from person to person either through patients or carriers by sneezing, coughing or even loud speaking, and hence overcrowding is a great predisposing factor. Fatigue and overwork by lowering resistance also act as predisposing causes.

The disease is characterised by high fever, severe headache, vomiting, and stiffness of the neck in the beginning and stiffness of the whole body later on. The disease is a very serious one, with a very high rate of mortality, and hence every case should immediately be sent to the hospital, or put in charge of a qualified doctor. The treatment consists in proper nursing and ingiving sulfonamides by mouth under the supervision of a qualified medical man, and proper nursing.

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[1] Hindi, *Slaishm Jawar*

[2] Hindi, *Mastishka Sushumniya Jawar*

Prevention of the disease lies in isolating the patients, preventing overcrowding especially in bedrooms, avoiding cinemas, etc., and in avoiding fatigue, overwork, etc. and spending as much time as possible in the open air.

Diphtheria[1].—It is a dangerous disease in which there are fever and symptoms of sore throat with the formation of a membrane in throat, nose or larynx, which in later stages causes obstructions to the air passage and death from suffocation or heart failure. The disease is commonest in children between 2 and 5 years. The disease is highly contagious and infection is spread by droplets of saliva in coughing or of mucus in sneezing or indirectly by utensils, handkerchiefs, towels, bed clothes, thermometers, pencils and pens. Convalescents may harbour germs for a long time and act as carriers of infection and start fresh epidemics. Incubation period is two to seven days.

Prevention consists in isolation of the sick and disinfection of utensils, towels, bed clothes, etc., and active immunisation of the child population by injections of diphtheria toxoid at one month intervals, in second 6 months of life (may be combined with Tetanus toxoid and whooping cough vaccine). Treatment must be in the hands of an experienced physician. Sickness must be notified to medical officer of Health, who would take preventive measures in schools and colleges.

Other important diseases carried by air are Chickenpox, Anterior Polimyelitis or Infantile Paralysis, Acute Tonsillitis, German Measles and Rheumatic Fever. Their spread and prevention are similar to other air-borne diseases described above.

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[1] Hindi, *Khanthrohini*

DISEASES CONVEYED THROUGH WATER

Cholera[1].—This is a dangerous disease characterised by vomiting, purging, cramps, suppression of urine and collapse, followed in some cases by a febrile reaction. This disease is caused by a germ known as cholera vibrio.

The infection always occurs from another cholera case and is usually indirect : (*a*) through water used for drinking, contaminated by washing of vegetables, clothes or dishes, or by bathing, (*b*) through adulteration of milk with infected water and (*c*) through contamination of food, such as butter, cheese, ice-cream, etc. The germs are conveyed to water or food through carelessness in disposal of cholera-stools. Flies may also convey the disease. The infection may also be conveyed through *cholera-carriers*, that is, healthy persons who pass germs in their stools without showing any symptoms of the disease themselves, and who are thus liable to set up epidemics of cholera. Persons with diarrhœa or indigestion or those who eat unripe or over-

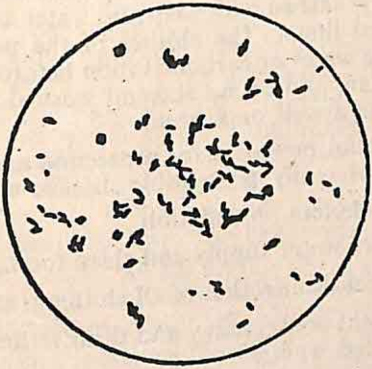

Fig. 25.—Cholera germs as seen under a microscope (greatly magnified).

(*From Curtis' Essentials of Practical Bacteriology*) ripe fruit, or are exposed to chill, are specially lialbe to get this disease. So we should take particular care to avoid these predisposing causes when cholera cases are occurring in any locality.

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[1] Hindi, *Wesushika*

The incubation period of the disease is very short, being two to five days.

The stools of a cholera patient should be received in a basin (*gumla*) containing lime, ashes or carbolic lotion of a strength of 1 in 20, and until they are burnt or carefully buried, away from all sources of water supply, they should be carefully protected from flies. After touching the patient or anything coming in contact with him, the hands should be thoroughly washed with soap and water and then soaked in chlorinated lime. The clothes of the patient must be put in boiling water or carbolic lotion before being given to the washerman, and on no account washed in a stream or canal or near a well or a pond.

The essential measures for protection against this, very dangerous but easily preventible disease are:

1. Anti-cholera inoculation.
2. A pure water supply and clean food.
3. Careful disinfection of all clothing, etc.
4. Efficient conservancy and disinfection of stools and vomited water.
5. Banishment of flies.

When cholera cases begin to occur in any place, all the wells in the locality should be disinfected by chlorination.

During the period that the epidemic lasts, a person should be stationed at each well to prevent people from washing or bathing on or near the well. People must not be permitted to put their own *gharras* or other utensils into the well, but a *dol* with an iron chain should be kept for the purpose and the person stationed on the well should draw water for all, and pour it into their *gharras.*

It is preferable to drink boiled water. The sale of over-ripe and under-ripe fruits should be forbidden.

The diesease being very serious, a qualified doctor should immediately be consulted and treatment carefully carried out.

Typhoid or Enteric Fever[1].—This is an acute infectious disease characterised by fever of some (usually three) weeks' duration, tenderness of the abdomen, and constipation, though diarrhœa in which the stools resemble pea-soup is occasionally present. Its germs are present, in the stools and urine, not only during the attack but for several weeks after the end of his fever; and the 'carriers' may remain infective for years. The methods of infection as well as of prevention are similar to those for other water-borne diseases, as, for example, cholera,. The *most common means* by which the infection of enteric fever finds its way into the body is by way of the alimentary canal, as, for instance, along with water or milk. Innumerable instances are on record in which direct contamination of wells, springs, rivers, and cisterns, with infected fæcal matter has been followed by enteric fever outbreaks. The infection has sometimes been traced to the use of polluted water for washing out the milk cans or for diluting the milk.

The disease is commonest in the age group 5 to 15 years and usually occurs in the autumn and spring. The incubation period is seven to fourteen days.

Immunity from the disease can be obtained by prophylactic inoculation. The protection afforded usually lasts for one year, and so the inoculation should be repeated every year. The fluid used for the purpose of the inoculation is an emulsion of dead enteric germs and is absolutely harmless.

The fever is very exhausting and proper treatment and nursing are essential to save life.

Dysentery [2].—This is an expression for a group of dseases, in which there is straining and passage of stools containing mucus, or mucus and blood, with griping and pain in the abdomen. There are many varieties, two of which are important, one caused by a minute animal known as an

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[1] Hindi, *Antrik Jawar*
[2] Hindi, *Amatisar*

amœba, and the other by a *bacillus*. The type caused by bacilli usually takes an acute course. That due to the amœba is chronic in its course and may give rise to an abscess in the liver. Bad food, bad sanitation, famine, fatigue, exposure to cold, indigestion, overcrowding and exhausting diseases are all predisposing factors. The incubation period is one to two days. The methods of spread and prevention are similar to other water-borne diseases, for example, cholera.

Diarrhœa[1].—This is frequent passage of watery stools. There are many types of this disease, such as diarrhœa caused by (*a*) the mechanical irritation of the bowels by coarse or badly chewed food or unripe fruit, (*b*) by chemical irritation such as by drinking 'brackish' water containing salts, (*c*) by disease germs, or (*d*) by poisons produced in the body itself. It is clear that if allowed to continue it may develop into a serious disease. Diarrhœa is especially dangerous in infants, and, in their case, an imperfectly cleaned feeding bottle is the chief cause, traces of milk that are left in the bottle providing an ideal food for the germs to grow in.

The methods of spread and prevention in the case of bacterial diarrhœa are similar to those for other waterborne diseases.

DISEASES CONVEYED THROUGH THE AGENCY OF FOOD

Malta fever.—We have already stated that tuberculosis, cholera, typhoid, dysentery and diarrhœa may be conveyed through infected food. In addition to these *Malta fever* is almost always a food conveyed disease. It is characterised by periods of febrile attacks alternating with normal or subnormal temperature, profuse sweats and muscular and joint pains, and the disease lasts for many months. It is caused by a small germ which is conveyed through the milk of diseased goats and rarely from one human being to another. The incubation period is generally fourteen days.

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[1] Hindi, *Atisar*

The prevention of the disease lies in avoiding goat's milk altogether or drinking it only after thorough boiling.

Hookworm disease[1].—Hookworms are small cylindrical worms which infest the itestines in large numbers and suck the blood, causing severe anæmia, debility and heart weakness. Large numbers of ova are passed in stools. If excreta is thrown in the fields and is not properly disposed, the ova develop into larvæ which burrow into skin of feet and ankles, and enter into blood stream and thus reach the heart and lungs. From here they pass up the trachea to the back of the mouth and are swallowed with food and thus reach the small intestines. Here they attach themselves firmly to the mucous and feed on blood and cause anæmia. The disease is very prevalent in rural areas all over the country.

Prevention consists in the treatment of human beings and killing the worms in their intestines, provision of latrines and improper disposal of night-soil, wearing of shoes and improvement in general sanitation.

Other important worms that infest the human intestines are round worms, tape worms, and thread worms. Pervention is similar to that of Hookworm disease.

DISEASES TRANSMITTED BY THE AGENCY OF INSECTS

We have mentioned above that the germs of tuberculosis, typhoid, cholera, dysentery, etc., may be mechanically carried from the sputum or excreta, as the case may be, of a person suffering from one of these diseases to milk or other articles of food, by simply sticking to the body of a common house-fly. The house-fly is consequently one of the deadliest enemies of mankind.

Plague, from which millions of people used to die every year in India, is caused by germs which are carried from rats suffering from the disease, by their fleas which live on their skin and suck their blood, and then bite man and introduce the germs into his blood.

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[1] Hindi, *Ankush Krim Roag*

Yet another important disease from which people suffered greatly in India was *malaria*. The micro-organism causing this disease is a small amœba-like organism which lives inside the red corpuscles of a man suffering from this disease. The organisms are sucked with the blood by a mosquito. They grow and multiply enormously in the body of the mosquito, and are then introduced into the blood of a healthy person, by the bite of an infected mosquito, and are thus the means of producing the disease. The part played by these and other insects in causing various diseases is so important, that we shall consider in greater detail in the next chapter.

Questions

1. What do you understand by the terms, 'Virus', 'Bacteria,' 'Spores', 'Resisting Power,' 'Immunity', 'Infectious diseases' and 'Incubation period'?
2. Describe some of the habits of germs. How may they sometimes act as our friends?
3. What are the important infectious diseases? How may they be conveyed to a healthy person?
4. What diseases are conveyed by direct contact? How may these be avoided?
5. What is hydrophobia? How is it caused and how should it be immediately and ultimately treated?
6. How do you differentiate between small-pox and measles? What is vaccination and what are its advantages?
7. What are the pre-disposing causes of tuberculosis? What are its symptoms and what precautions should be taken by a patient?
8. How is cholera caused? What precautions should be taken by persons in the house, where a patient is suffering?
9. What is Hookworm disease and how it is spread.

CHAPTER XII

DISEASES CARRIED BY INSECTS

Malaria—As mentioned in the last chapter, malaria is a disease, the organism causing which is conveyed from one person to another through the agency of the mosquito Malaria, although its name implies bad air, has nothing to do with the purity or impurity of the air. The important symptoms of malaria are repeated attacks of fever coming on with shivering and a feeling of cold, and going away with sweating. If untreated, successive attacks of malarial fever lead to enlargement of the spleen, anæmia or blood-lessnes, pigmentation of the face and general weakness.

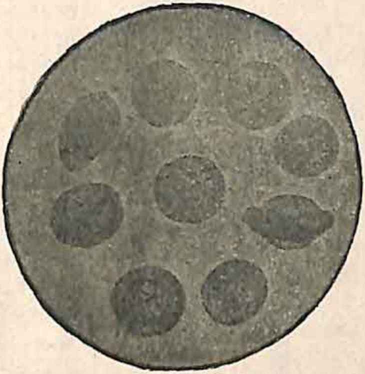
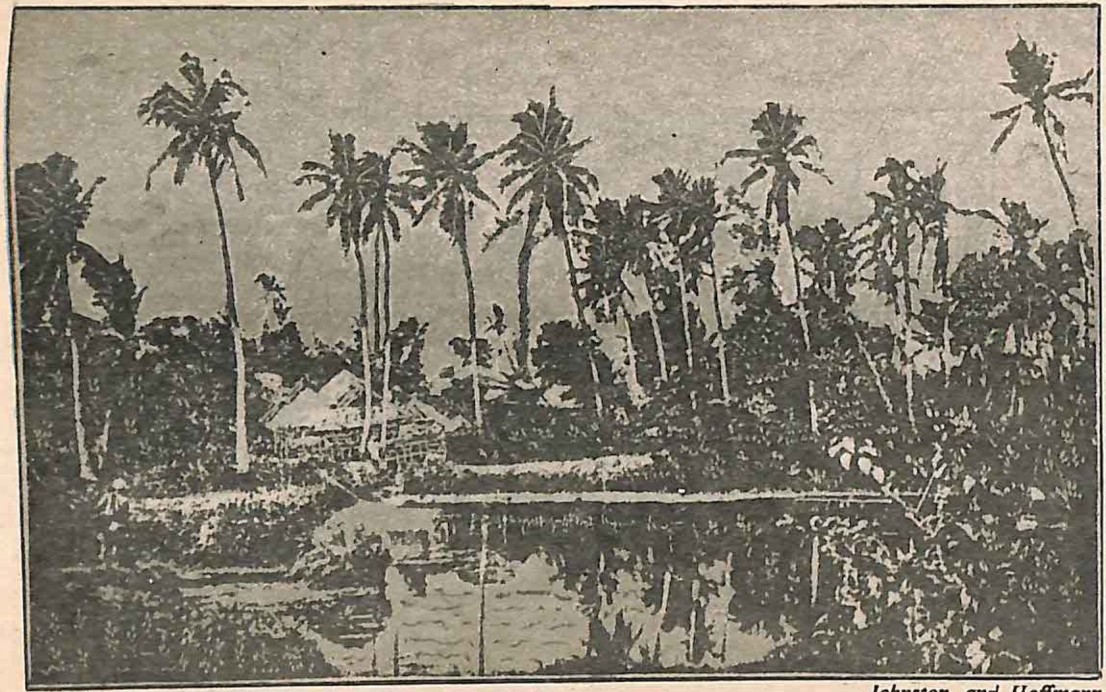


Fig. 26.—Human blood infected with malarial parasites as seen under a microscope.

The organism which causes malaria is a small one-cell animal which multiplies in red corpuscles and by the breaking up of the corpuscles the newly formed malarial parasites are set free in the blood plasma, and take up their abode in other corpuscles. Now if a mosquito of the Anopheles variety feeds upon the blood of such a man, the malarial parasites are taken up by the mosquito along with the blood and multiply rapidly within the body of the mosquito. They get into the salivary glands of the mosquito and are injected into the wound when this infected mosquito bites another person. In nature malaria is spread only through the agency of the mosquito and in no other way, and for its prevention we have to take offensive and defensive measures against this insect. It can also be transmitted through blood transfusion if sufficient precautions are not taken in examining the donor's blood.

The mosquito lays its eggs in little groups on the surface of the water in which the earlier part of its life is spent, and it cannot reproduce, therefore, if the water is drained away. This is why malaria is so common after the summer rains when water has collected in puddles etc. Hence, whenever possible, the drainage of lakes, ponds and pools is the best preventive measure against malaria. Another method is to sprinkle crude kerosene oil (Pesterine) or D.D.T. by means of a sprinkler from about a foot on the edges of the water, as the oil forms a film on the surface of the water, and the mosquito larvæ being unable to breathe quickly die; or again mosquitoes may be kept down by introducing into the collections of water their natural enemies such as certain kinds of fish. When full grown, the mosquito leaves the surface of the water and flies off as an adult insect. In this state the mosquitoes hide themselves in nooks and corners, among clothes and furniture, etc., in the rooms, and can be killed by subjecting them to the action of cresol vapour : or by the use of spray containing 5 per cent D.D.T. in kerosene oil once a week as explained in connection with plague. But the chief measures against them are defensive. The anopheles mosquito feeds at night and we should protect ouselves by sleeping under mosquito nets. After sunset exposed parts should be protected by rubbing a preparation made by mixing equal parts of kerosene oil and sweet oil and scenting it with a little citronella oil or by rubbing one of the anti-mosquito creams available in the market. The body can also be protected against malaria by taking prophylactic doses of chloroquin phosphate, which kills malaria parasites as soon as they enter the blood. Chloroquin phosphate as a preventive medicine should be taken in 0.5 gm. doses every seven days. The incubation period of malaria is



Johnston and Hoffmann

Fig. 27.—Breeding place of mosquitoes.

seven to fourteen days, and if sufficient chloroquin phosphate is taken within this period, all the parasites injected by the bite of the mosquito, are killed. For children, the prophylactic doses of Chloroquim phosphate should be correspondigly smaller.

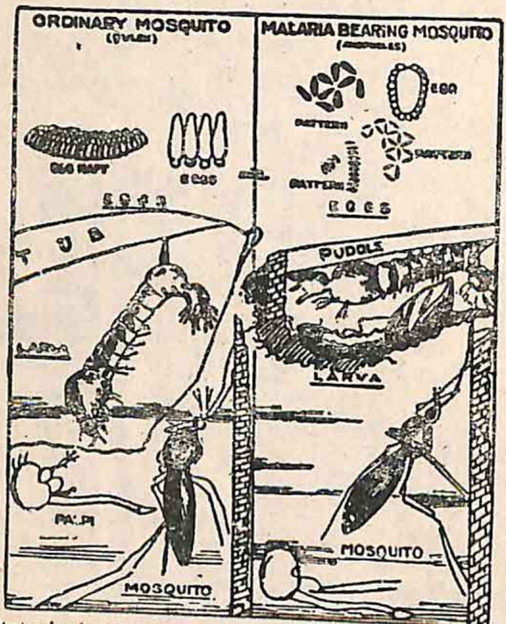


Fig. 28.—States in the life-history of the ordinary (culex) and the malaria-bearing (anopheles) mosquito compared.
(*From Parker and Bhatia's Zoology, Macmillan and Co.*)

Filariasis [1].—These are small worms found in the blood of a person suffering from the disease. The intermediate host is a mosquito, whose bite spreads the disease. It is characterised by inflammation of lymph vessels and lymph gland fever and swelling of affected issues. Recurrent attacks lead to thickening of tissues known as elephantiasis. Lower limbs and scrotum are commonly affected.

Prevention consists of destruction of mosquitoes, use of mosquito nets and treatment of infected persons.

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[1] Hindi, *Tanusotra rooja*

Dengue[1].—It is also spread by the bite of mosquitoes. There is fever of 5 to 7 days, and pain in back and limbs, and rash like measles which disappears in 2-3 days. These cause severe debility with loss of appetitie and sleep etc. Prevention lies in destruction of mosquitoes, use of mosquito nets etc.

Plague[2].—Another important disease whose germs are carried by insects is plague. About fifty years ago plague worked havoc in most states of India. The plague germ is a minute organism which is found in the blood of rats suffeering from plague and is conveyed from rat to rat through the agency of the rat flee (fig. 29), which lives in the hair of the rat and feeds on its blood.

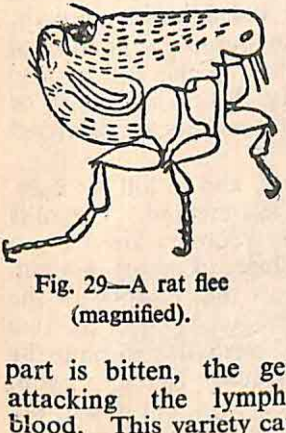

Fig. 29—A rat flee (magnified).

Thus the first sign of an outbreak of plague in any locality is mortality among rats. When the rats are dying, the rate fleas leave the dead rats and hunt about for food. Then they may attack human being, injecting plague germs in them by their bite and may set up an epidemic or plague. If the bite occurs on one of the superficial blood vessels, the germs directly enter the blood producing the *septicæmic form* of plauge, but if any other part is bitten, the germs move along the lymphatics, attacking the lymphatic glands before entering the blood. This variety causes swelling of the superficial lymphatic glands (bubos) and is known as the *bubonic plague*. But a third variety of plague which we shall deal with separately is the *pneumonic plague*, in which the lungs are attacked causing pneumonia. This last form has nothing to do with rats and fleas.

It is now clear that the best preventive measure against plague is to protect ourselves from rats by building rat-proof houses. Rats only go where they find food and shelter and these should not be afforded them, through proper cleanliness and orderliness of the house. When plague threatens any village or part of a town, attention should be concentrated on rat destruction. The three methods popularly employed are trapping, baiting and the smoking of rat-holes. In trapping, care should be taken to wash the trap with soap and warm water, to oil it with sweet oil, and to change the food material frequently, otherwise rats will not enter it. When caught, the rats may be drowned and buried, and on no account should they be set free in another locality, a practice, very often followed in large towns. For baiting, a rat-poison such as arsenic, phosphorus or barium carbonate is mixed with *Gur* and *Atta* (sugar and flour) and made into small pills which are put in different corners, safely out of the reach of children and domestic animals. The smoking of rat-holes is done by burning a mixture of sulphur and *Bhusa* (straw) and blowing the smoke into the holes by means of bellows (fig. 30). Care must be taken that all holes from which smoke escapes are plastered with mud.

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[1] Hindi, *Shoolasith Jawar*

[2] Hindi, *Mahamari*

To disinfect plague-infected rooms and to kill rat fleas, fumigation by cresol vapour is the best method. Cresol is a dark phenyle-like liquid. For an ordinary sized room (say ten feet by ten feet) put two ounces of cresol in a cup and let it slowly evaporate on a slow fire, closing all the doors and windows, and allow it to have its effect for two hours. Another and more popular method is to pour the cresol on a few smouldering cow-dung cakes. Cresol, though unpleasant, is not a poison to man, but it will kill insects such as fleas. Fleas are also killed by 10 per cent D.D.T. in kerosene oil and used by pressure sprayer.

Since it is essential to take all possible precautions against this serious disease, the natural resistance of the body against plague germs should be increased by means of *anti-plague inoculation*. Persons who have been inoculated have far less chance of suffering from the disease, and even should they get an attack, they are less likely to die from it, than uninoculated persons. Ordinarily inoculation against plague does not produce any serious ill effects though in old people and people in weak health, the reaction may be severe. The protection from inoculation lasts for a period ranging from six to ten months.

Pneumonic plague is also caused by the plague germ, put the disease has no connection with rats or rat fleas. The germ is conveyed from one person to another by the inhalation of infected dust or expired air. The sputum and expired air of a pneumonic plague patient are full of myriads of plague germs and are extremely infectious, so much so that whole families contract the disease and die. The symptoms of disease resemble ordinary pneumonia, but are more marked. There is high fever, pain in the chest, troublesome cough with markedly blood-stained sputum. The best precaution against such a dangerous disease is for no one except those who are in charge of the case, to go to the patient or to go near his house. The attendants should wear face masks.

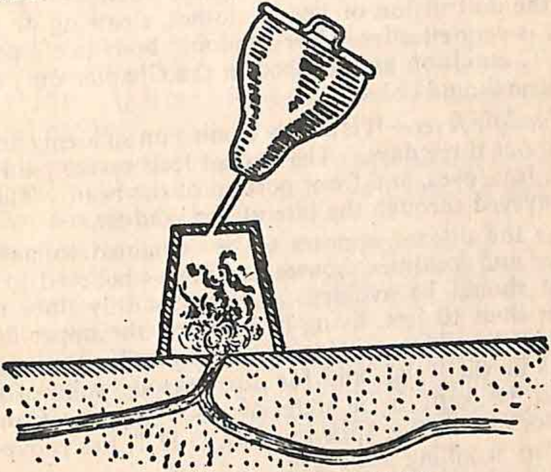

Fig. 30.—Smoking the rat-holes.

Relapsing fever is caused by small spiral shaped germs which are found in large numbers in the blood while the fever lasts. They are conveyed from a sick person to a healthy individual through the agency of the louse or a tick, in whose body they undergo multiplication.

The disease is characterised by a sudden onset of high fever which lasts for five to seven days, after which it goes down suddenly. The temperature keeps low for a week, when the patient again gets an attack of high fever which lasts for five days or so. These remissions and relapses may reccur two or three times. The disease occurs in epidemics in the dry districts, where it is responsible for a large number of deaths during the winter and spring seasons.

Prevention consists in personal cleanliness, removal of hair infected with lice, and frequent changes of clothing. For the destruction of lice in clothes, steaming or boiling them is very effective. For head and body lice 2 per cent D.D.T. emulsion as described in the Chapter on Personal Hygiene should be used.

Sand-fly fever—It is a fever coming on suddenly and lasting about three days. The patient feels severe pain in the back, legs, eyes, and front portion of the head. The virus is conveyed through the bite of the sand-fly.

As the disease appears to be confined to particular houses and localities, houses and places believed to be infected should be avoided. As the sand-fly does not fly higher than 10 feet, living in room on the upper floors in infected localities, is a good safeguard. It breeds in cracks in the wals, and for this reason walls of houses should be kept in a state of good repair. Combined outdoor and indoor spraying with D.D.T. has proved very effective in killing sand-flies.

Kala-azar—It is a chronic disease characterised by enlarged spleen, emaciation, anæmia and skin pigmentation transmitted by sand-flies. The disease is caused by small intracellular bodies called 'Leishman-Donoron bodies' found in the liver, spleen, etc. Prevention is similar to that of sand-fly fever; but as man is the source of infection, treatment of patients will reduce the number of persons harbouring the infection and thus prevent spread of the disease.

Scabies[1]—Scabies or 'the itch' is a contagious disease caused by the presence of a parasite in man's skin.

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[1] Hindi, *Khujali*

It is characterised by the formation of burrows and intensive itching, which is most troublesome when the infected person is in bed or in a warm room. As a result of this itching there are many scratch marks on the body, and a pustular infection commonly supervenes.

The parasite is very small, just visible to a person with good eyesight. The female penetrates the epidermis and lays its eggs there. The complex life cycle from egg to adult takes about 8 days. A period of 2 to 3 weeks, or even longer, passes between infestation and the development of symptoms.

The common sites for the burrows are those areas of the skin which are soft or folded, like webs of fingers; front of the wrists, the front of the axillæ, the buttocks and the umbilical region.

The disease spreads rapidly from one person to another by contact, and conditions of over-crowding and poor personal hygiene greatly help in this.

Preventive measures consist of maintaining personal hygiene at a high level and avoiding the interchange of towels, shirts, shorts and bedding. Infected garments should be well ironed.

The disease if treated with sulphur ointment, benzoate emulsion or derris root lotion or cream in strict accordance with the instructions given by the physician cures scabies in 3 or 4 days.

Other important diseases which are carried through the bites of insects are the following:

African sleeping sickness by the bite of the tsetse fly.

American Yellow fever by the bite of the mosquito.

Flies as carriers of diseases.—Who is not acquainted with the dirty habits of the common house-fly? It breeds in manure and likes to feed on dirt and dung. As mentioned before, the germs of typhoid fever, cholera, dysentery and diarrhœa are passed out in the excreta, and it is clear that flies can transmit these disease germs from the excreta to the food. The legs of the fly are covered with numerous hairs and germs stick to these and are mechanically transferred to food when the fly sits on it.

The fly is, therefore, a great enemy of mankind, and efforts should be made to exterminate it. It is impossible to do so by trying to kill flies by 'fly paper' etc., because they breed very rapidly. A single fly lays about 120 eggs, usually in horse dung, or any vegetable or animal refuse. In six to eight hours they hatch into larvæ (maggots) which are little whitish worm-like creatures. After feeding on the refuse for about five days they become quiet and change into pupæ and in five to six more days they change into adult flies. The most effective method of exterminating flies is to provide for the systematic removal of stable manure, and to keep kitchens, markets, etc. perfectly clean. Manure can be profitably spread out on the fields. From time to time treatment of manure, compost heaps, refuse dumps, night-soil trenches and other places where flies breed by D.D.T. has proved effective. One application will prevent breeding for about five weeks.

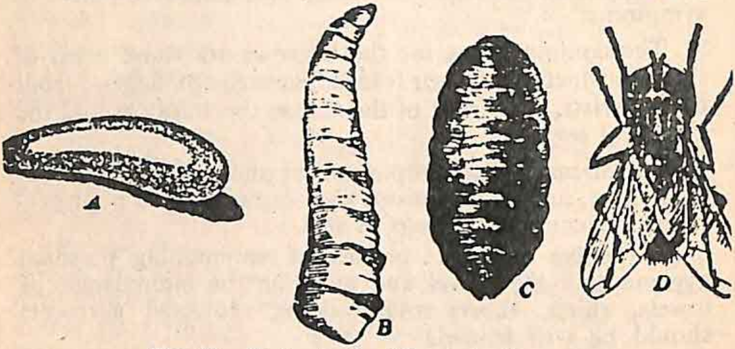

Fig. 31.—States in the life of the house-fly. A—egg, B—larva. C—pupa, D—mature fly. (*From Caldwell and Eikenberry : Elements of General Science, Ginn and Co.*)

Until flies can be exterminated or their numbers greatly reduced through improved sanitary conditions, the least we can do is to keep all our food covered and protected from flies. We should not purchase sweets from sweetmeat-sellers who do not keep them covered. And lastly whenever a case of typhoid, cholera, dysentery or diarrhœa occurs, the excreta of the patient should be suitably disinfected and the access of flies to it prevented by keeping it covered.

Questions

1. What important diseases are carried by insects? How is malaria caused? What part is palyed by the mosquito in the spread of this disease? How will you destroy mosquitoes?
2. What do you know about Sand-fly fever, Kala-azar and Sleeping sickness?
3. Write a short note on the fly, and the part played by it in the spread of diseases. How will you control fly breeding?
4. Write a short note on scabies.

CHAPTER XIII

DISINFECTION AND DISINFECTANTS

SINCE all the communicable diseases like Plague, Tuberculosis, Cholera, Typhoid and Small-pox, are caused, as has been explained in a previous chapter, by the germs of those diseases getting into the body, it is of importance that these germs, wherever found, be killed, or their growth checked as fast as possible. This is the object of disinfection; and the articles employed for this purpose are called disinfectants.

Disinfectants are substances which destroy germs, e.g. carbolic acid. These should not be confused with Antiseptics or substances which only arrest the action of germs, e.g. intense cold arrests the growth of germs but does not kill them. *Preservatives* are closely allied to them and are employed to prevent the decomposition of organic substances, such as the preservation of fish by adding salt to it. *Deodorants* are substances which remove bad smells, either by destroying them, e.g. charcoal, or overpowering them by their own stronger odour, e.g. phenyle. It is therefore important to remember that by simply removing bad smells we do not kill germs, and hence the use of deodorants merely gives a false sense of security against disease. The use of deodorants, especially those which merely act by overpowering bad smells but not killing germs which are the cause of decomposition, should be discouraged.

Disinfectants proper can be grouped under the following sub-heads:

1. Natural Disinfectants.
2. Physical Disinfectants.
3. Chemical Disinfectants.

Natural Disinfectants.—Sunlight kills most disease-producing germs. Thus, typhoid bacilli are killed in two hours, if exposed to the direct rays of the sun. In the presence of air and moisture, the sun's rays, by promoting oxidation, will kill even resistant organisms.

Fresh air is a powerful, though slow disinfectant. It acts chiefly on account of the presence of oxygen in it, and there are many kinds of germs which can only flourish in the absence of that gas.

Drying also acts as a disinfectant for some germs, such as cholera vibrio, while for other germs, e.g. tubercle bacilli, it only prevents their growth and thus serves as an antiseptic.

Physical Disinfectants.—No life can be sustained in the presence of *intense heat*, and therefore, heat is employed in various forms to kill germs. For cheap articles destruction by *fire* is the best method for killing germs. Small articles can be burnt in the chimney in the dwelling room, as there would be risk of spreading infection if they were taken into the kitchen for this purpose. Big articles can be burnt in specially contructed apparatus called *incinerators*. All articles which are made wet by discharges from the patient should be burnt before they get dry as by the time they dry up, the germs will be floating in the air. The direct heat of the fire may be used to disinfect metallic vessels etc. and the practice among the Hindus of cleaning infected utensils by hot ashes is not without some use. The common practice of getting the spoons, cups, etc. of the patient tinned before being used by others is an efficient method and should be resorted to whenever possible.

Boiling.—Clothes, bedding etc., are usually disinfected by boiling. The common disease-producing germs are destroyed by boiling for twenty minutes to half an hour.

Hot air.—This method is not very effective because hot air has very little penetrating power and takes an inconveniently long time to disinfect bulky articles. It may also injure articles such as wool, leather ard silk. Fabrics are not only liable to be scorched but may become changed in colour, shrink, and lose their elasticity and gloss. Fusible substances like glass and wax are melted and over drying renders many articles brittle. Articles which would be injured by boiling or expsoure to steam, such as furs, books India rubber, etc. can be effectively disinfected by dry heat, if care is taken *not to raise the temperature too high*. Exposure to a temperature of 120°C. for one hour is usually sufficient.

Steam is very largely used for disinfecting purposes. Steam under pressure penetrates into bulky and badly conducting articles such as quilts, pillows, clothing. It is also very effective as it undergoes condensation when coming in contact with a cold body, and thus imparts its latent heat also. Comparatively low temperature for a shorter time suffices for adequate disinfection. Thus, body lice and their eggs lying in clothes are destroyed by exposure to steam at 100°C. for ten minutes, but most germs need fifteen or twenty minutes. Steam disinfectors are usually kept by Health Departments of Municipalities, and every town should have one or more disinfecting stations where people might send their clothes for free disinfection after every illness from an infectious disease in the house.

Chemical Disinfectants.—These may be in either solid, liquid or gaseous. For a chemical to be effective as a disinfectant it must come in intimate contact with the infected article and, therefore, liquid preparations are preferable, and also because they can be much more effectively distributed. It is important to remember that a solid disinfectant is useless unless it is in solution as it is powerless to act upon the organisms. The result also depends on the nature of the material to be disinfected because in many cases organisms are protected by the surrounding organic matter. Thus for example mercury perchloride has a tendency to combine with albuminous matter and become inert. Again, no disinfectant can be expected to act instantaneously, for it cannot act at once upon all the organisms present. Time must be allowed for its action. An *ideal* disinfectant should be non-poisonous to higher forms of life, cheap, readily soluble in water but strong enough to kill disease-producing organisms. It should not injure utensils in which it is placed or articles exposed to its action, nor should it possess an offensive odour.

It is difficult to find disinfectants possessing all these properties. Those most commonly employed are discussed below. It must be remembered that most of them are deadly poisons and if kept in the house, should be placed under lock and key and never within the reach of children.

Carbolic acid.—It is a colourless, deliquescent crystalline substance of a characteristic odour. On keeping, it becomes liquid and pinkish in colour. It is usually used as a solution in water of a strength of 1 in 20 or 1 in 40. Discharges from cholera, typhoid, dysentery and diarrhœa patients are mixed with equal quantities of 1 in 20 carbolic lotion, while all infected articles such as clothes etc. should be soaked in the lotion for at least one hour before giving them to the *dhobi*. The weaker lotion (1 in 40) is used for washing wounds etc.

Mercury Perchloride or Corrosive Sublimate.—This is a heavy, colourless, crystalline disinfectant. It is one of the most powerful disinfectants and forms a colourless, odourless solution, extremely poisonous to man.Unless acidilated, it coagulates albumen, and its power to penetrate into the interior of organic matter is thus limited. It is largely employed as a solution of 1 in 1,000 for washing hands, wounds, etc., while a strength of 1 in 500 is needed for disinfecting clothes and discharges. Mercury lotion has also a strong antiparasitic action and is used for destroying lice on the head and ringworm, but should be used with great care, so that none of it gets into the mouth.

It is usually sold in the form of tablets tinted blue to render it and the lotion made from it easy of recognition and to prevent its being swallowed by mistake. The solution should not be kept in metallic receptacles as it corrodes them.

Potasssium Permanganate:—It is in the form of dark purple, fine slender crystals, and posssesses a tendency to give up oxygen readily in the presence of organic matter so that its solution which is at first a deep violet pinkish colour quickly turns dark brown. It stains fabrics. It is a useful disinfectant, deodorant and antiseptic, but its action is very limited on account of its giving up oxygen in the presence of organic matter in which the micro-organisms usually flourish. Vegetables that are eaten raw should be washed in a weak solution of potassium permanganate.

Lime.—Fresh burnt time composed of whitish masses is a cheap and useful germicide. It has a tendency to absorb water, and on doing so it swells and cracks, with great evolution of heat, and falls into a powder known as slaked lime. Its chief use is as a whitewash for the walls, where it serves to destroy germs sticking to the walls. It is also used for disinfecting wells, for which purpose about a maund of it is thrown into an ordinary-sized well. It is important to remember that if stored for any length of time, it is converted into chalk which has no action as a disinfectant.

Chloride of lime (bleaching powder) is dull white powder, smelling offensively of chlorine. It corrodes metals. Its disinfecting action is due to the fact that in the presence of moisture and an acid (even carbonic acid) it splits into hydrochloric acid and oxygen. It tends to dissolve albumen and other organic matter; and its action becoming exhausted in this way, micro-organisms may escape alive. Its chief use is to purify water for drinking purposes, water used by soldiers during a campaign is regularly chlorinated on a large scale, to render it safe.

Chlorine is a yellowish, irritant and heavy gas, which diffuses badly and needs moisture to act as a disinfectant.

It has greater bleaching properties than sulphur dioxide, and is on the whole more expensive and less convenient to use than that gas, although it is many times stronger. It is usually produced by the action of sulphuric or hydrochloric acid on bleaching powder. It is advisable to use 2 lb. of bleaching powder and 1 lb. of commercial acid for every 1,000 cubic feet of air space. The mixture should be placed high up in various parts of the room. All metal fittings and articles of silk etc., should be removed before hand. After disinfection, if difficulty is experienced in entering the room to open it, a towel saturated with weak ammonia solution should be placed over the mouth.

Sulphur Dioxide is a colourless, pungent gas, diffusing badly and having a slight bleaching action on colours. Bronze, gilt and copper surfaces are tarinished by it. It has marked disinfecting properties. For disinfecting rooms, about 2 lb. of sulphur should be burnt for every 1000 cubic feet of space. A sufficiency of moisture must be present in the room, if the gas generated is to exert disinfectant properties. If the pan containing sulphur to be burnt, is placed in a shallow dish containing water owing to the amount of heat evolved in burning, aqueous vapour is formed from the water in sufficient amount to saturate the atmosphere. The gas should be evolved as high as possible in the room and at more than one place unless the room is very small.

Formaldehyde gives off colourless non-poisonous colours, very irritating to the eyes and throat, which serve as a powerful disinfectant and deodorant. For disinfecting rooms, if employed in sufficient quantity it fulfils all the requirements of general practice. It does not affect colours, or metallic surfaces (with the exception of iron) and is stronger than sulphur dioxide. It can be best liberated from formalin (solution of formaldehyde in water) by heating it under pressure or by pouring formalin on permanganate of potash. Five ounces of permanganate mixed with ten fluid ounces of formalin are sufficient to disinfect 1,000 cubic feet, an exposure of six hours being necessary. The method is simple, rapid, effective and comparatively inexpensive, but the person using it should quickly withdraw himself from the room after pouring the liquid over the permanganate.

Saponified cresol is a dark liquid derived from the distillation products of coal. It is a cheap and effective disinfectant and parasiticide. It can either be used as an emulsion in water for disinfecting drains, dirty linen, etc., or as a gaseous disinfectant by evaporating it off into a room. For the latter purpose about two ounces of cresol are required for 1,000 cubic feet of space. It is either slowly heated on a spirit lamp or poured on smouldering cow-dung cakes. It does not bleach colours or corrode metals, and it is not irritating or poisonous to higher forms of life. It is extensively used for disinfecting houses in plague infected villages.

Before using any of the gaseous disinfectants mentioned above for disinfecting a room, all the doors, windows and other outlets should be carefully closed, and the last one shut on coming out after starting their action.

Phenyle is a dark thick liquid which becomes milky white on the addition of water, and has a characteristic odour. It is a weak disinfectant but is largely used as a deodorant for latrines, drains, etc.

Soap.—Common soap is a weak disinfectant, the alkalis in it also washing away the greasy material which frequently surrounds the germs as they are commonly found. A person exposed to infection, as when attending a person suffering from an infectious disease, should wash well his hands, body and clothes with soap, if he has no access to the other more powerful disinfectants mentioned above.

Precautions to be taken when an infectious case is in the house. Intimation must be sent to the Medical Officer of Health authotities, and the patient separated from the rest of the family—or isolated as it is called—and kept in a well ventilated room. For the sick room, choose, if possible, once on the uppermost storey, and remove all furniture except the patient's bed, a table for the medicines and a chair for the attendant or nurse. Keep the windows and ventilators open the whole time, and if the patient feels cold, use an extra blanket instead of closing the windows. Do not hang chicks or curtains in the passages, but a large sheet should be hung on the door completely covering it, and kept wet by carbolic acid solution, 1 to 20. This will not only ensure privacy but prevent the spread of germs by gusts of wind. Discourage visitors, and if allowed at all, they should not be permitted to stay for more than a few minutes. Even the nurse or attendant should not mix freely with other members of the household, and before seeing other persons, should change her outer garments and wash her face, hands, etc., with some disinfectant.

The attendant should wash her hands every time after touching the patient, and the thermometer must be kept in spirit in the interval between uses. Every article leaving the sick room, such as cups, spoons, etc., should first be disinfected by boiling and if possible, the patient should have a set of everything for himself. All soiled linen must at once be put to soak in 1 to 20 carbolic lotion in an enamelled tub and left for two hours before they are given to the dhobi. The bed pan and urinal ought to be disinfected with 1 to 20 carbolic or 1 in 500 corrosive sublimate solution, and stools disinfected while in the bed pan with twice their bulk of the same disinfectant. Mix these up thoroughly by stirring with stick and leave them for two hours before they are taken away. Disinfect urine with equal parts of 1 in 20 carbolic or 1 in 500 mercury perchloride solution.

During convalescence, the patient should be given only those books to read which can be destroyed afterwards. On no account ought books from public libraries be given to him as these may become a source of spreading the disease. Similarly, patients, especially those suffering from an air-borne disease, should not travel in crowded trains or hired carriages. During convalescence and when the skin is peeling off after an eruptive fever, some oily substance such as carbolic oil or carbolic vaseline must be rubbed on the skin to prevent scales from flying about.

After the patient has recovered, disinfect the room as well as the bed, bedding and other furniture in the room. The simplest way to do this is by burning sulphur or cresol in the room. About two ounces of cresol or two pounds of sulphur are needed for 1,000 cubic feet of space. Sulphur needs the presence of moisture to be effective; and hence water should be boiled, and steam allowed to escape simultaneously in the room. Keep all the chinks, ventilators and doors closed for twenty-four hours and then flush the room thoroughly with fresh air by keeping open all the doors, windows and ventilators for two or three days.

If even this simple measure cannot be adopted, expose all the furniture to the sun for three or four days, turning the sides of the blankets etc., every three to four hours. Wash all the washable things with a disinfectant and wash the ceiling and floor throughly, preferably with a disinfectant such as mercury lotion 1 in 500 and also lime wash the walls.

Questions

1. What are disinfectants and under what sub-heads would you divide them?
2. What is a deodorant?
   Give examples and explain why the use of deodorants should not be encouraged.
3. Define the properties of an *ideal* disinfectant.
4. What precautions should be taken when an infectious case is in the house?

CHAPTER XIV

PARASITICIDES AND INSECTICIDES

Parasiticides are drugs which killl parasites infesting the surface of the body, such as lice and itch. The important parasiticides are Sulphur, Benzyl Benzoate, D.D.T. and Derris roots.

Sulphur is a yellow gritty powder; its 10 per cent ointment kills itch or scabies. After thorough scrubbing with soap and water, and then drying, the ointment is rubbed into the burrows of the itch. It is very effective, but is liable to cause irritation in delicate skins.

Benzyl Benzoate is chemically prepared and occurs as colourless crystals or colourless oily liquid. As 25 per cent emulsion it is used in the treatment of scabies.

D.D.T. is chemically prepared, and occurs as white crystalline powder or granules. It is used in the treatment of lice and itch. Its 2 per cent emulsion kills lice and itch. Antilouse powder containing 5 per cent D.D.T. is also very efficacious. A few drops of the emulsion or powder are put on various parts of the head and thoroughly rubbed by hand. The head is not washed for 10 days. Similar is the treatment for itch. As the smell is pleasant and they do not cause irritation, D.D.T. and Derris have largely replaced older drugs in the treatment of scabies and lice.

Derris.—It is the root of a plant and is used as two per cent lotion or cream for the treatment of lice and itch. When applied after washing with soap and water, it will kill the parasites in 3-4 days.

Insecticides are drugs which kill insects like bed bugs, cockroaches, fleas, flies, mosquitoes and their larvæ. The important ones are Gemmexane, D.D.T. and Derris.

Gemmexane is a white solid, chemically prepared, and is effective against the same insects as D.D.T. and Derris. All these are used as a spray diluted with kerosene or as dust with the aid of a pressure sprayer. These are applied over refuse dumps, manure heaps, night-soil trenches, where flies breed, or on the edges of ponds and puddles where mosquitoes breed, or in places where bed bugs, sand-flies, or fleas are found. One application will stop breeding for about a month, when the spray should be repeated. For killing adult mosquitoes, rooms, especially corners, places behind doors and curtains, should be sprayed once a week, as is done in army barracks and bungalows in cantonments. The combined outdoor and indoor spraying with D. D. T. and Gemmexane has revolutionised the control of mosquitioes, flies, sand-flies, etc.

Questions

1. Describe the properties of Sulphur, Benzyl Benzozoate, Gemmexane, D.D.T. and Derris.
2. How and for what purpose are Gemmexane, D.D.T. and Derris used?
3. What do you understand by the terms, Parasiticides and Insecticides, and how do they differ from disinfectants?

CHAPTER XV

URBAN AND RURAL SANITATION

Opportunities for healthy life.—It is an indisputable fact that people in the country have a better opportunity of leading a healthy life than those living in towns. People living in villages have great natural advantages in their favour. There is an abundant supply of fresh air, pure unadulterated food-stuffs are easily obtainable, and the majority of people live an outdoor life. Yet they suffer from bad housing conditions, impure water-supply, absence of proper drainage, storage of dung heaps close to their houses, and other insanitary conditions which help in the spread of various diseases. In towns on the other hand, in spite of congestion and overcrowding various hygienic needs are looked after. In large towns we have Municipal Committees consisting of representatives of the people, who are expected to look after the various health problems of the town. Plans for building houses have to be first approved by the Municipal Committees. In more advanced countries it is insisted upon that some open land is left in front of and behind every house, and proper provision is made in building the house to meet sanitary requirements. The height to which a house can be built is determined by the width of the street. The Municipal Committees provide a pure water-supply, arrange for the proper scavenging, watering and lighting of roads, maintain dispensaries for the sick, arrange for the inspection of food-stuffs, and devise means for checking the spread of infectious diseases. Gardens are laid out and open spaces provided to serve as 'lungs' for the congested parts of the town.

Offensive trades.—There are certain trades, such as slaughtering of animals, bone-boiling, fat-melting, paper- and hide-making, which are a source of nuisance and injurious to public health. These are called offensive trades. These also include trades in which coal dust, stove dust, iron dust, flour dust are inhaled and cause lung disease among workers. All these trades should be secluded from crowded areas and need sanitary supervison.

Rural Sanitation.—A large majority of the people in India live in the villages, and naturally the sanitary condition of the village homes reacts upon the health of the nation. The present unhealthy state of things can be much improved *by the application of the general laws of Hygiene described in the previous chapters*. Much of the apathy of the village folk is due to their ignorance of the simple laws of health. It is, therefore, the duty of every educated man who comes in contact with the villagers to explain to these people the advantages of general cleanliness. Unless the villagers themselves understand the value of fresh air, pure water-supply, domestic cleanliness and neat roads and surroundings, little improvement will be effected. Individual villages cannot meet the expenses for all their sanitary needs, but the object can be achieved by villages uniting together and having a common water-supply etc. So long as that is not done, individual effort should be directed towards the following measures:

1. Each living-room should be well lighted and have at least an outlet and an inlet for proper ventilation

2. Animals must not be kept in rooms used for domestic purposes. Rooms occupied by cattle should be well lighted and ventilated and should have *pucca* washable floors so that no smells occur. If possible, the stables should be outside the village or at most on its outskirts, care being taken that they are not near any drinking water supply.

3. Grain should not be stored in the rooms used for sleeping purposes. There should be separate store-rooms, preferably rat-proof.

4. Earth required for house building should be taken from a distance from the village so as not to cause excavations which would get filled with water after the rains, and act as breeding places for mosquitoes.

5. The water-supply for drinking purposes must be properly cared for. As far as possible, shallow wells should be discarded and deep wells substituted for them. All the directions about the proper looking after wells should be rigidly followed. As tank water is liable to be polluted in several ways, it should be condemned. If no other arrangement be possible there ought to be separate tanks for animals, washing clothes and drinking purposes. The tanks reserved for drinking purposes ought to be outside the village and at some distance from the grave-yards, brick kilns, manure heaps, etc., These should be fenced round by strong wire and should have no trees in the immediate neighbourhood, as leaves falling into the tank will decay and pollute the water. It would be much better if pumps can be placed in a few places to draw out the water from the tank, and proper drainage provided for the waste water. River and canal water should always be looked upon with doubt, as it is difficult to protect them against pollution.

6. The village headman should see that no stale vegetables and unripe or over-ripe fruits are exposed for sale. The sweetmeats should not be made of unwholesome articles and should be properly cooked. The halwaies should observe cleanliness, and the sweets should be kept in wire-gauze cupboards. The shop should not be used for sleeping at night.

7. People should be advised to take rubbish, refuse and cowdung to some fixed places outside the villages and deposit them there till required. As suggested by Mr. Brayne, everyone with separate cultivation must have his pit six feet deep, ten or twelve feet wide and as long as he requires. These pits must be far enough away for the smell not to reach the village and near enough for the people to carry everything to it and not be tempted to throw it down

on the way. When one pit is full, it should be covered with earth and left to manure and another pit dug up for use. The pitting of manure will give the farmer double the quantity and the quality of the manure will also be twice as good, thus increasing the value of manure fourfold. Trench latrines and bore-hole latrines should be used by villages as explained in the chapter on Refuse and Refuse Disposal.

No one should be allowed to ease himself in the streets and the owners of the houses should be held responsible for the cleanliness of the street in front of their houses.

8. The practice of making cow-dung cakes (*uplas*) and using them as fuel must be given up. Making dung cakes ruins the crops, degrades the women, makes them filthy and wastes their time. A stack of *upla* takes months of female labour to make and is worth Rs. 10; as manure it is worth Rs. 50.

To quote Mr. Brayne further cattle-dung, human excreta and village sweepings are provided by Providence to give you bumper crops. You burn the first and use the second and third to poison the air and the water and ruin the health, sight and physique of yourselves and your children. In the village the stuff is poison, in the fields it is gold and silver. Why keep it in the village!

As already mentioned, the Planning Commission appointed by the Government of India has undertaken to raise the living conditions of the people both in towns and in villages. In the latter case they are doing this by Rural Reconstruction by the help of coummunity projects, and rural extension services, village planning, making, of model villages in each Tehsil. Electricity and pure water supply are being extended to villages. It is hoped that in a few years villages will be healthier and more comfortable to live in than cities.

E. R. T
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Questions

1. Compare the sanitary conditions in towns and villages. Why is life in villages healthier than in towns?
2. How can rural sanitation be improved? Why is it so very important?

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